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A GENETIC ANALYSIS OF HUMAN EYE COLOR

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TWO FIGURES

INTRODUCTION

The present study was originally undertaken as an exercise in the analysis of human genetics by comparison of siblings; a method which, from a purely practical point of view, is excellently suited to human material. The length of the generation in man makes it extremely difficult to obtain adequate data for the conventional type of analysis by comparison of successive generations. Two generations at most can be compared by refined and accurate observation; in order to bring in a third generation we must either attempt to compare with accuracy individuals of whom the youngest will rarely have attained maturity before the eldest slips past his sixtieth year; or else fall back on the hearsay testimony of untrained observers, as, for instance, exactly what color Grandpa's hair was when he was a young adult.

The sibling method is by no means new, though it is still relatively unfamiliar in genetic literature. Its use has been associated with human rather than animal genetics (since it offers no advantages to the latter) and both the method and the subject have lagged behind in genetic research. It should be frankly admitted, in fact, that human genetics is, from the point of view of genetics as a science, a parasitic growth. The difficulty of exactly defining such traits as we will deal with in this paper precludes any dabbling with the newer developments of genetic theory, such as chromosomal aberrations, though in a mathematically inexact way we may be

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able to point out evidences of linkage. The geneticist, in fact, may say that human material is not suitable for genetics; and sometimes it may be difficult for him to grasp the obverse fact that genetic methods are nevertheless very useful to anthropology.

Genetic analysis by comparison of siblings can be developed in several ways. Its simplest application is in dealing with rare traits which will be found to occur in approximately half the members of each family in which they are present, if dominant, and in approximately one-quarter of the members of the family, if recessive (Weinberg, '12; reference and summary in Baur, Fischer and Lenz, '31, pp. 507–508). In dealing with normal variations which are relatively common in the population, however, it is necessary to take into account the population frequencies and hypothetical gene frequencies of the traits under consideration. When two traits are being considered simultaneously, as in the investigation of linkage, the matter becomes complex. Mathematical formulas can be devised to handle these complications (Penrose, '35, '38; Haldane, '36; Fisher, '37; Cotterman, '37). A prerequisite to the legitimate use of such mathematical exactness, however, is a clear-cut demarcation of the traits being studied, such as exists in the case of blood-groups. Insofar as the phenotypes grade into one another, as in human hair color, for instance, the correspondence between genotype and phenotype cannot at best be any more exactly defined than the phenotypes themselves. The stage in which precise formulae can properly be applied to the type of data with which anthropology deals is still far ahead. The preliminary work involves a great deal of observant exploration to determine as nearly as possible how many factors may be involved in any trait and what their effects and interactions are.

The sibling method of analysis is based on the same pattern of inheritance which is more commonly visualized in the form of a pedigree. The basic principle of Mendelian inheritance is that each parental gene is transmitted to half the offspring. Considered from the point of view of a single genera-

tion, this means that each gene which an individual carries is present also in one-half of his siblings. The accompanying diagram will present a familiar aspect to anyone who has dealt with problems of heredity. It represents, however, not the offspring of known parents, but the siblings of a known individual. The known factors are two genes of a given individual with the gene formula XX′ of a certain factor pair. One of these genes came from a hypothetical parent "X?", the other from a parent "?X′ ", each parent having one unknown gene in addition to the one the individual of reference received. In their offspring, the sibs of the known individual, four genotypes appear in equal numbers: XX′, X?, ?X′, and ??.

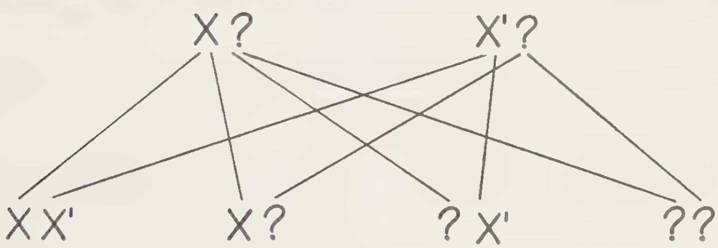


Fig. 1 Diagram illustrating the genetic constitution of the family of an individual with the gene formula XX′ of a certain factor pair; top row, his parents; second row, his siblings.

The unknown factors denoted by "?" introduce the statistical complications; for if the genes X and X′ are common in the population, some of the siblings X? and ?X′ are actually of the genotype XX′, and some of the siblings ?? carry genes X or X′ or both. (The "??" group of siblings will have the same distribution of genotype as an unselected sample of the population, with of course a due proportion of XX′.)

It is useful to think of three degrees of sibling resemblance in regard to any two factors: identity, as between XX′ and XX′; similarity, as between XX′ and XX or X′X′; and difference, as between XX and X′X′. In traits which involve more than one gene pair, a more complex series of degrees of resemblance and difference will be present. Siblings which have in common all the factors controlling a given trait will be

phenotypically alike; the frequent occurrence of phenotypic identity between siblings is of course due to the greater than random probability of sharing any one of the two or more genes involved. However — this is an important point in analysis of factors — genotypes which share some but not all of their determining factors may present different phenotypes, though they reveal their partial genetic likeness by a tendency to appear as siblings of one another. In the simplest case, where only one gene pair is involved, and three phenotypes are present, there will be two phenotypes (those which represent the genetic formulae XX and X′X′ respectively) which will rarely occur both in the same family; i.e., XX siblings of X′X′ individuals will be uncommon, and vice versa. The third phenotype will appear with moderate frequency among siblings of either XX or X′X′; this third phenotype represents the genotype XX′. The relative frequencies with which each phenotype occurs among the siblings of individuals of other phenotypes form the basic data for the sibling analysis of any trait. Though the approach is somewhat oblique in comparison to the more familiar type of pedigree analysis, an important objective may be obtained: the explanation of phenotypic variation of any given trait in terms of a system of interacting factors which are fewer in number than the outward variations which they produce.

The number of factors which we may expect to find is largely a function of the number of categories in which we see fit to group our data: and the exactness with which factors may be analyzed is unfortunately affected by the way in which categories are chosen. A single category of observation (as, for instance, "blue eyes") may represent a definite two-factor genotype, although within the group there may be minor variations which represent the interplay of many modifying factors. There is also a possibility that some individuals placed in a category may be basically different from the majority in regard to genetic determination, as, to give an obvious case, an albino in the series would in some respects be classified with normal blondes. A true albino could easily

be recognized and eliminated; but analogous situations undoubtedly exist throughout the data, so that we must be on the lookout for the possibility that quite different genes may mimic one another in phenotypic effect. In some cases we may be able to detect the deception with the data at hand; in other cases further investigation with more minute observation may be necessary to clear up the matter. The great range of variation in the traits with which we are concerned makes it impossible on a first attempt to take into account all fine differences and distinctions. These difficulties of observation introduce into the analysis an indefiniteness which must always be borne in mind. But if we expect to study such traits genetically at all, we must not allow it to discourage us unduly.

MATERIAL

The individuals in this series were for the most part residents of Boston and vicinity, with a few from other parts of the state. The only conscious selection was to obtain families with the largest number of available brothers and sisters over the age of 18. The study began among personal acquaintances, and from there its scope was extended solely by the helpfulness of the families studied in suggesting further prospects. Since the good will which carried the investigation along proved to be independent of social and educational attainments, the group became a fairly representative sample of the community, though with some bias in favor of the college group in which the study began. The only economic selection was a purely practical one which virtually excluded families without private telephones.

In all 126 men and 174 women were studied. These 300 individuals represented eighty-three groups of siblings, ranging from two to eight siblings per group. The number of sib-pairs (comparisons of each individual with each of his siblings) was 466. Full anthropometric measurements and extensive observations were made on each individual, so that the present paper represents only a fraction of the material obtained. The ages of the persons studied ranged from 18

to 66, with the majority in the twenties. The greatest age difference between siblings was 19 years.

PIGMENTATION OF THE IRIS

A binomial system was used in observing the color of the iris, to allow for adequate description of the class of mixed eyes, which was large and varied in the group studied. The eye color of each individual was recorded first under one of ten categories covering the color range of background or base color, from light blue-gray to dark brown; and then under one

TABLE 1

Eye color observations, by sex

BACKGROUND COLOR	PER CENT	
	Men	Women
Light blue-gray	3.2	6.3
Medium blue	26.9	27.1
Dark blue	16.7	9.2
Medium gray	3.2	4.0
Dark gray	7.9	4.6
Medium green	23.0	23.6
Dark green	7.1	7.4
Light brown	6.4	6.8
Medium brown	5.6	7.6
Dark brown	. .	3.4
No. of cases	126	174

	PER CENT OF TOTAL	
	Men	Women
Specks present	12.7	21.3
Scallop darker	30.2	27.0
No. of cases	126	174

DETAIL COLOR	PER CENT	
	Men	Women
White (or gray)	37.4	20.2
Yellow	10.3	13.6
Orange	7.1	15.4
Brown	27.8	26.6
Red-brown	17.4	24.2
No. of cases	126	169

DETAIL AREA	PER CENT	
	Men	Women
Absent	.8	1.9
Small	57.2	55.2
Medium	35.3	39.0
Large	6.7	3.9
No. of cases	119	154

of five categories describing the secondary or detail color (table 1). Detail color ranged from white to red-brown. The white detail color denotes the common marking of pure light eyes, a pattern of greater or less extent laid out in whitish opaque tissue overlying the blue or gray of the iris.

A notation was made also of detail area, since irides with the same component hues may vary greatly in apparent color, due to difference in the relative areas occupied by the com-

ponent hues. Occasionally the detail marking is darker near the pupil, bringing a third hue into the combination. This is recorded under the heading "scallop darker" since this darkening is generally at or near the slightly elevated scallop line surrounding the pupil. Specks, which often appear even in eyes otherwise typically light, were also noted if present.

Since thirty-nine different combinations of background and detail color appeared (out of a possible fifty) some simplification was required to reduce the eye color types to a reasonable number. The preliminary sorting into eight types is given in table 2.

The first step in ascertaining the genetic relationship of these types is to find how frequently any two color types appear together in the same family. By using the sibling pair as a unit we avoid the complications introduced by differences in total size of family. In a family having three Light-eyed individuals and one Dark-eyed one, for instance, there are six sibling pairs; three Light × Light and three Light × Dark. In tabulation each pair is entered twice; the three Light × Dark pairs count as three Darks in the column of siblings of Light, and as three Lights in the column of siblings of Dark. The three Light × Light pairs count twice in the same column, once on behalf of each member of a pair. (It is easy to overlook the latter rule in adding up the data. The oversight causes paradoxical results, as in the family above, where it would make the Light-eyed individuals appear to have as many Dark as Light-eyed siblings.)

Table 3 shows that all of the eye color types, with the exception of the small groups Dark Brown-Mixed and Near Dark, show a definite tendency to repeat within the family, as would be expected if they were genetically determined at all. In addition there are numerous combinations of types which appear with special frequency, indicating a common partial genetic determination for eye color types which differ in detail. In comparing percentages of siblings in any column with the total population percentages, it should be remembered that a sib frequency only equalling the population fre-

TABLE 2

Classification of eye color types

DESIGNATION	%	BACKGROUND	DETAIL	GENERAL APPEARANCE
I. Light				
A. Pure Light	17.0	Blue or gray	White (or gray)	*Pure Light:* all shades of blue or gray, from nearly white to "violet."
B. Near Light	10.0	Blue or gray	White (or gray) with scallop line darker or specks present	*Near Light:* the same as Pure Light, except if specks are very conspicuous.
II. Mixed				
A. Yellow-Mixed	22.7	Blue, gray or medium green	Yellow or orange	*Yellow-Mixed:* ranging from apparently blue or gray through green to (rarely) yellow. All "green" eyes fall in this class. The mosaic of blue, gray or green background with yellowish detail often produces an illusion of change of color with changing illumination.
B. Brown-Mixed				
1. Light Brown-Mixed	9.7	Blue, gray or medium green	Brown or red-brown, small in area	*Light Brown-Mixed:* often passing in casual observation as Light eyes of their background hue, as the brown is localized near the pupil and blends with it.
2. Medium Brown-Mixed	17.3	Blue, gray or medium green	Brown or red-brown, medium in area	*Medium Brown-Mixed:* usually referred to as light brown or hazel, since the detail color predominates.
III. Dark				
A. Dark Brown-Mixed	1.7	Blue, gray or medium green	Brown or red-brown, large in area	*Dark Brown-Mixed:* appear entirely brown except to close scrutiny.
B. Near Dark	6.0	Dark green		*Near Dark* and *Pure Dark:* ranging in color from light to dark brown.
C. Pure Dark	15.7	Light, medium,		

quency denotes some degree of genetic relationship. Since the percentages of the most closely related types fall above random expectation, other percentages must fall below; the percentages which fall lowest indicate a lack of common genetic factors, except such as are universal in the population studied; the intermediate cases indicate the presence of some factors in common.

TABLE 3

All sibling comparisons of eye color, irrespective of sex

(Since the total representation of the various types is widely varied, their relations among themselves may be more readily comprehended if the table is read horizontally, comparing each percentage with the total percentage in the extreme right column. The probable error of the difference between any column per cent and the corresponding total per cent may be calculated, if desired, by the formula $0.6745\sqrt{p(100-p)/N}$, where $p =$ the total per cent and N = the number of cases in the column (bottom line.))

EYE COLOR OF THEIR SIBLINGS IN PER CENT	EYE COLOR OF INDIVIDUALS								
	Pure Light	Near Light	Yellow-Mixed	Light Brown-Mixed	Medium Brown-Mixed	Dark Brown-Mixed	Near Dark	Pure Dark	Total
Pure Light	42.2	22.1	19.5	11.8	8.3	6.2	9.4	3.4	17.8
Near Light	12.7	16.8	7.3	11.8	13.4	6.2	9.4	3.4	10.2
Yellow-Mixed	24.1	15.8	41.0	9.7	8.3	56.4	17.0	17.7	22.0
Light Brown-Mixed	6.6	11.6	4.4	15.1	15.9	6.2	13.2	10.2	10.0
Medium Brown-Mixed	7.8	22.1	6.3	26.9	21.7	6.2	22.7	25.8	16.8
Dark Brown-Mixed	.6	1.1	4.4	1.1	.6	..	..	2.0	1.7
Near Dark	3.0	5.3	4.4	7.5	7.6	..	3.8	8.9	5.7
Pure Dark	3.0	5.3	12.7	16.1	24.2	18.8	24.5	28.6	15.8
No. of cases	166	95	205	93	157	16	53	147	932

Light and Near Light show evidence of a common partial genesis. But they are by no means identical, in spite of the slight observational difference between them, since each repeats within the family more frequently than it occurs with the other. The two are about equally distant genetically from the three darkest types. In relation to the mixed types Light and Near Light differ. The Pure Light eye is associated with the Yellow-Mixed eyes, but does not often appear in families

in which Brown-Mixed eyes occur. The reverse relation is found in the case of the Near Light eye, which is more closely related to Brown-Mixed than to Yellow-Mixed types.

The Yellow-Mixed and Brown-Mixed types show a marked genetic antagonism (the small group of Dark Brown-Mixed being an exception). The Yellow-Mixed eye is a pronounced repeater within the family, and is more closely related to both both Light and Dark eyes than to the Brown-Mixed types which, in amount of total pigmentation, approach it more closely. The distinction in hue between yellow-orange and brown detail color is evidently very significant genetically.

The Light Brown-Mixed and Medium Brown-Mixed are distinguished principally by the closer association of the Medium Brown-Mixed type to Dark. In relation to one another they show, paradoxically, a closer relation to each other than either bears to itself. Even pure chance could not produce quite this relation; apparently the two are essentially identical genetically, and the curious result is an error of sampling.

The very small group, Dark Brown-Mixed, shows a positive relation only to Yellow-Mixed and Dark. This column is included only to show why, in the larger grouping, this type was combined with the Dark rather than the Brown-Mixed types.

Near Dark and Pure Dark are close genetically as in appearance. Near Dark reflects its relatively lighter hue by a greater frequency of occurrence in families of the lighter types. Its failure to repeat within the family shows, however, that it is essentially a variant of the Pure Dark type, appearing sporadically in Dark-eyed families. The dark green background by which it is characterized is, it should be noted, a muddy olivaceous color much less akin to the clear green typical of the Yellow-Mixed eye than the terminology might suggest.

SEX LINKAGE OF EYE COLOR

The original tabulation of traits of the iris showed a 17% excess in white detail color of the iris (i.e., in Light eyes) in males as compared with females. The preponderance of

darker eyes in women has long been known and evidence of sex-linkage has been shown. Winge ('21) showed evidence of sex-linked dominance of "brown" over "blue" in two-generation series; more recently Penrose ('38) has shown that sex-linkage of eye color can be demonstrated in sibling comparisons, though the unsatisfactory classification of his data made the results statistically inconclusive for the size of series which he used.

Since a sex-linked character is one determined by a factor lying in one of the X-chromosomes, of which the female possesses two, the male only one, it appears more frequently in the female, if dominant, and in the male, if recessive. Its genealogical migrations are characterized by the fact that it cannot be passed from father to son; since all children receive one X-chromosome from the mother, and individuals with two X-chromosomes are ipso facto female, the paternal X-chromosome automatically renders female those offspring on which it simultaneously confers its contained genes. Thus the daughters of a family inevitably share certain genes, derived from the father, from which their brothers are disinherited; though the corresponding maternal genes are distributed indiscriminately among daughters and sons. Hence in respect to traits governed by sex-linked genes there is a closer likeness between siblings of the same sex than between those of opposite sex, as well as a general sex difference in favor of the dominant among females.

In respect to distribution of a sex-linked trait, families may be divided into two classes; those in which the father and all daughters are dominant, though the recessive may appear in the sons if carried by the mother; and those in which the father is recessive, and daughters and sons have equal chances, depending on the heritage of the mother, of receiving a dominant gene. A recessive female can occur only in a family in which the father is recessive; in such families any dominants which do occur are due to the presence of a dominant gene in the mother, which is equally likely to be manifested in siblings of either sex. The dominant male can only occur

in families in which the mother carries at least one dominant gene; hence his sisters are at least as likely to be dominant as his brothers. In the long run, dominant males have more dominant sisters than brothers, since in some of these families (dominant father × heterozygous mother) the daughters are all dominant, the sons only half dominant.

Most of the sex difference is found, however, among the siblings of recessive males and of dominant females, since these two classes draw heavily upon the families with dominant fathers in which the dominant appears in the daughters quite independently of the inheritance which the sons receive. The recessive male and dominant female are frequently siblings of one another; it is these sibling pairs which are characteristic of sex-linkage. Formulae could be given for exact expectations in these various cases, for each population frequency of dominant and recessive genes. These however would apply only if the dividing line between the true phenotypes was precisely drawn by our classification of observations. More general rules, which can be applied more successfully to imperfect data, are given in table 4. It should be noted that these generalizations will distinguish a sex-linked trait clearly enough from a partially sex-influenced one (such as quantity of body hair). A trait abetted by endocrine factors due to sex would show a constant sex difference; not, as in the case of the sex-linked trait, a sex difference confined to certain classes of families.

In assembling the tables of sibling comparisons divided by sex, the eye color types have been reduced to four main divisions; Light, Yellow-Mixed, Brown-Mixed and Dark. This consolidation is necessary to keep the groups from becoming too small to give significant results.

Since the primary fact which suggests sex-linkage of eye color is the greater frequency of Light eyes in males, it is evident that Light will be the recessive, if the difference is to be explained in terms of sex-linkage. In this event the sex difference in frequency of Light eyes should be at a maximum in the families of Light-eyed males, but not evident at all in

TABLE 4

A. Types of families with respect to sex-linked genes.

TYPE	FATHER	MOTHER	SONS		DAUGHTERS	
			Recessive	Dominant	Recessive	Dominant
I	x	XX	..	X	..	Xx
II	x	Xx	x	X	xx	Xx
III	x	xx	x	..	xx	..
IV	X	XX	..	X	..	XX
V	X	Xx	x	X	..	XX Xx
VI	X	xx	x	..	..	Xx

B. Sibling relations in sex-linked traits.

PHENOTYPE AND SEX OF INDIVIDUAL	TYPES OF FAMILY IN WHICH PRESENT	CHARACTERISTICS OF FAMILY	NET SEX DIFFERENCE IN SIBLINGS
Recessive female	II	No sex difference	Dominant and recessive equally common in brothers and sisters
	III	No sex difference	
Recessive male	II	No sex difference	Great excess of dominant sisters as compared with brothers
	III	No sex difference	
	V	Dominant present in all females, half of males	
	VI	Dominant present in all females, no males	
Dominant female	I	No sex difference	Great excess of dominant sisters as compared with brothers
	II	No sex difference	
	IV	No sex difference	
	V	Dominant present in all females, half of males	
	VI	Dominant present in all females, no males	
Dominant male	I	No sex difference	Moderate excess of dominant sisters as compared with brothers
	II	No sex difference	
	IV	No sex difference	
	V	Dominant present in all females, half of males	

the families of Light-eyed females. The respective differences are actually 35% in the former case and 7% (not statistically significant) in the latter. It is evident that in many families a further factor supervenes to prevent Light eyes in females where it appears in males. Such a factor fulfills the expectation of a sex-linked dominant. This sex-linked "non-Light" dominant, however, need not include all non-Light eyes. The

TABLE 5

Sibling comparisons of eye color, divided by sex.

EYE COLOR (PER CENT)	SIBLINGS OF LIGHT-EYED MALES		SIBLINGS OF LIGHT-EYED FEMALES		SIBLINGS OF YELLOW-MIXED-EYED MALES		SIBLINGS OF YELLOW-MIXED-EYED FEMALES	
	Brothers	Sisters	Brothers	Sisters	Brothers	Sisters	Brothers	Sisters
Light	64.6	29.9	57.5	50.7	37.0	23.7	38.3	19.4
Yellow-Mixed	15.4	23.4	22.5	22.8	37.0	44.7	36.1	43.0
Brown-Mixed	15.4	37.6	7.5	17.7	7.4	13.2	6.4	12.9
Dark	4.6	9.1	12.5	8.9	18.5	18.4	19.2	24.7
No. of cases	65	77	40	79	27	38	47	93

EYE COLOR (PER CENT)	SIBLINGS OF BROWN-MIXED-EYED MALES		SIBLINGS OF BROWN-MIXED-EYED FEMALES		SIBLINGS OF DARK-EYED MALES		SIBLINGS OF DARK-EYED FEMALES	
	Brothers	Sisters	Brothers	Sisters	Brothers	Sisters	Brothers	Sisters
Light	23.2	8.6	50.0	12.3	7.0	14.7	18.0	7.0
Yellow-Mixed	4.7	8.6	8.6	10.5	11.6	26.5	18.0	23.0
Brown-Mixed	32.5	42.8	25.8	47.4	39.6	26.5	35.9	34.0
Dark	39.6	40.0	15.5	29.8	41.8	32.3	28.1	36.0
No. of cases	43	35	58	114	43	34	39	100

EYE COLOR (PER CENT)	ALL BROTHERS	ALL SISTERS
Light	39.2	20.9
Yellow-Mixed	18.0	24.5
Brown-Mixed	21.6	30.2
Dark	21.2	24.4
No. of cases	362	570

shortage of Light eyes in the sisters of Light-eyed males is made up by excesses (as compared with brothers of the same families) of all three of the non-Light types, but not of all three to equal extent. The Brown-Mixed eyes partake most notably. The sex difference in frequency of Yellow-Mixed eyes is relatively small, but sufficient to show that the distinction between Yellow- and Brown-Mixed is independent of sex-

linkage; as far as the sex-linked factor is concerned, both are definitely on the dominant side of the fence. The trend towards Dark eyes in the sisters of Light-eyed males is very small; and though they show more Dark eyes than males of the same families, it should be noted that only a small fraction of the Dark eyes of the population are accounted for in these families at all. The majority of the Dark eyes are evidently not to be explained as dominant alternatives to the sex-linked recessive Light.

In examining the next series — siblings of individuals with Yellow-Mixed eyes — the families of the females of the type show, as would be expected, a greater sex difference. Recessive Lights are only half as common in sisters as in brothers of this group. The phenomenon is better shown, however, in the families of Brown-Mixed females. Here 50% of the brothers have Light eyes, only 12% of the sisters. Again the Brown-Mixed type shows the ratios of sex-linkage more unequivocally than does the Yellow-Mixed type. In both cases the difference is made up to some extent by Dark eyes as well as by intermediate types, showing that the Dark eyes are in part, if not all, sex-linked dominants. The siblings of males of Yellow-Mixed and Brown-Mixed types show, as is expected of the sex-linked dominant, some sex differences, though not as great as that shown in the families of dominant females. A question of considerable interest may be answered at this point; whether in any sense the Dark eyes bear the same relation to the Yellow- and Brown-Mixed types that the latter do to the Light type; i.e., whether the sex-linked eye-darkening factor turned intermediate color types to Dark when it was doubled, or when it was added to some other factor or factors which alone would produce an eye of intermediate coloration. If this were the case, the sisters of Yellow-Mixed and Brown-Mixed males would go disproportionately into the Dark category as the sisters of Light-eyed males go into the intermediate categories. This is very definitely not the case. Dark eyes are equally common in the two sexes in families of both Yellow-Mixed and Brown-Mixed males. This explains why

the difference in eye color between the two sexes of our population shows in Light and the two intermediate categories, but is almost absent in respect to the Dark type. The small excess of Dark eyes in women in probably due to an overflow of the sex-linked mixed types into this character.

Among the siblings of Dark-eyed females there is some excess of Light eyes and deficiency of Dark eyes in the brothers as compared with the sisters, in accord with the supposition that the Dark eyes are in part analogous to the sex-linked dominant mixed types. An unexpected situation, however, is encountered in the families of Dark-eyed males. Here the sisters appear definitely lighter-eyed than the brothers; the only such case in the tables. The sisters of the Dark-eyed males exceed the population average for the combined categories Mixed and Dark by only 4%, while the brothers of the same families show for the same subdivisions an excess of 39%. This difference is, in spite of the small series, statistically significant. The percentages would indicate that some of the Dark eyes occurring in males represent a sex-linked factor which is recessive, and of course quite distinct from the commoner sex-linked recessive Light. The apparently simple character of "Dark eye" must be suspected of concealing a diversity of genotype. Further elucidation of eye color depends on the examination of the structural variations of the iris as well.

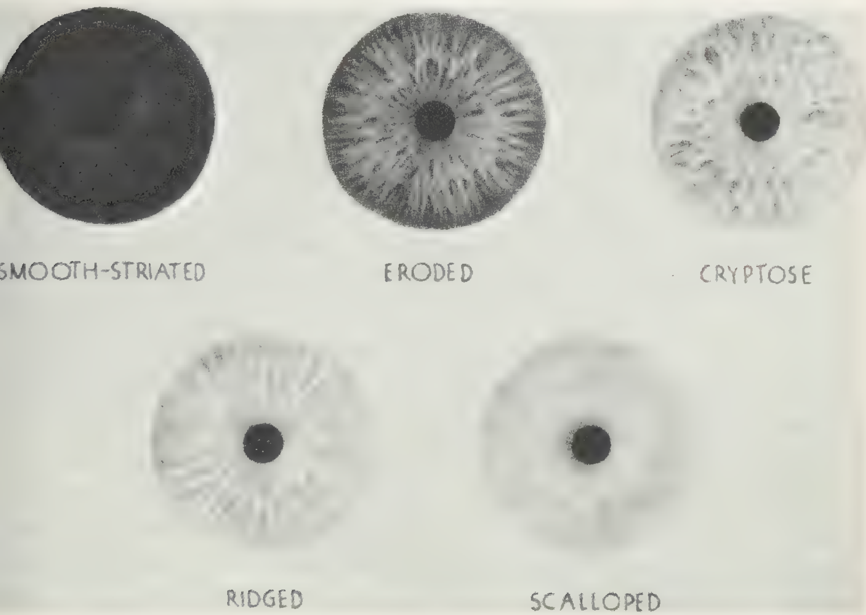
STRUCTURE OF THE IRIS

The structure of the iris, a less obvious characteristic than the color, has been subject to investigation only recently (Weninger, '34; Eskelund, '38).[1] Many irides, especially the lighter types, show an irregularity of surface, often in rather low relief, which is most easily observed when the iris is obliquely illuminated. The variations in structural detail are the result of the degree of retention of the topmost or anterior vessel layer of the iris (Duke-Elder, '34, p. 66ff). In most mammals and most races of men this layer is normally complete and

[1] Extensive unpublished data and color photographs by H. T. E. Hertzberg are in the files of the Department of Anthropology, Harvard University.

pigmented, producing a smooth-surfaced brown iris. In population groups showing partial or complete depigmentation of the anterior part of the iris, however, this membrane tends to atrophy; though, as our series shows, the individual correlation between color and structure is not inordinately high.

In this series the structure of the iris was observed with the aid of a pocket flashlight, which made it possible to illuminate the eye from the side. The low relief of the structural detail



g. 2 Standard or central types representing the five main divisions of iris structure.

is conveniently exaggerated when the light falls at an angle only a few degrees from the plane of the iris, and the fact that the light is barely visible to the subject and causes him no discomfort is an encouragement to prolonged examination. The division into a few main types of structure does not do justice to all the variations present, but served as a useful working system (fig. 2).

The perfectly smooth brown iris is not common in the group studied; nearly all of the brown eyes showed at least a radial striation of the surface. Since it is doubtful that these striae represent a real atrophy of the anterior layer, the "smooth" and "striated" types, as originally observed, have been combined for purposes of tabulation. The frequency of striation of the dark irides in our partially blonde population may be due to a thinness of the vessel layer, related to, but not a form of atrophy. The next type, also common in the darker types of eye, is termed "eroded." The eroded iris has deeper and wider furrows, still radial in direction, suggestive of gullies radiating out from a mountain — hence the term, borrowed from geology.

The most striking structural type of the iris is that termed "cryptose." In the cryptose iris some of the furrows have expanded, in the central zone midway between the pupil and the border of the iris, and come to resemble perforations in the anterior layer rather than gullies in it. There appears to be a critical point in the atrophy of the anterior layer beyond which there is not sufficient substance left in it to hold the separate fibers in their original radial position, so that the edges of the gap draw back into a rounded outline and form a typical crypt.

The next category "ridged" resembles the eroded type in some respects. Theoretically it is distinct — indicating a degree of atrophy more advanced than in the cryptose eye, so that the remains of the anterior layer consist of mere radial vestiges. In observation there may be some confusion between the two; but the eroded type in its typical form, as seen in the darker types of eye, and the ridged structures in typical form, as seen in lighter eyes, are characteristically distinct. In the cases of eyes of irregular pigmentation, the judgment between the two is sometimes doubtful.

The characteristic structural type of light eyes is termed "scalloped." In the scalloped eye the remaining structure of the anterior vessel layer is in low relief, and consists of an irregular circular ridge concentric to the pupil. This repre-

sents the most closely knit part of the anterior vessel layer — the zone in which the vessels loop over and anastomose. In a very few light eyes even this trace is absent, and the iris again may be termed "smooth," though it is hardly analogous to the primitive dark smooth iris. A small group, termed "scallop-and-edge" covered those cases in which a trace of the vessel layer remains at the periphery of the iris. The cases proved to be so few that the group was included in tabulation under the class "scalloped."

The categories used for describing iris structure form a fairly continuous series, and each class is subject to excusable confusion with the next. Irides which are typically eroded may have scattered crypts; some crytose eyes have areas in which the structure has degenerated into a ridged type; and some ridged irides border on scalloped. In many of the darker eyes the structure is not easy to discern, even in good light. It is thus necessary to examine the correlation between structure and color critically, as the color may bias the judgment of structure.

The correlation of structure and color raises the question of whether an eye with a fully developed anterior layer could be blue, or one with a completely atrophied anterior layer could be brown. The first question may be answered in the negative; since the elevated tissue which lies between crypts in a light eye is always white or grayish; it is distinguished by its opacity. The opaque, nearly white iris which rarely occurs in dogs and horses is undoubtedly the result of depigmentation without atrophy; nothing like this occurs in man.[2] The tissues of the gray iris may be thicker than those of the blue iris, and in this sense more closely analogous to those of brown eyes. Two cryptose eyes were found in which the bottoms of the crypts were recorded as light brown, indicating that fairly deep layers of the iris may be well pigmented in some cases.

As we proceed from light to dark in eye color the structure types scalloped and ridged, taken together, decrease through-

[2] Duke-Elder states that crypts are found only in man and the gorilla. However, flat wide crypts occur in the eyes of Siamese cats, and other domestic cats show a texture of the iris which is suggestive of some uniform atrophy.

out (table 6). In the mixed types ridged is, of the two, commoner than scalloped. This difference between the two should not be too much stressed, in view of the difficulties of judging structure in these variegated eyes. The percentage of cryptose and eroded irides, taken together, remains the same from Light through Brown-Mixed, and is less in the Dark group. The ratio of cryptose to eroded structure steadily decreases as we proceed from light to dark. The percentage of smooth

TABLE 6

Structure of the iris, by eye color and sex.

PER CENT IRIS STRUCTURE	EYE COLOR				SEX	
	Light	Yellow-Mixed	Brown-Mixed	Dark	Male	Female
Smooth-striated	12.3	19.1	50.6	77.2	30.2	46.0
Eroded	2.5	7.4	14.8	12.9	10.3	8.6
Cryptose	27.1	22.0	16.1	7.1	24.6	13.8
Ridged	28.4	30.9	13.6	1.4	20.6	17.2
Scalloped	29.7	20.6	4.9	1.4	14.3	14.4
No. of cases	81	68	81	70	126	174

PER CENT IRIS STRUCTURE	LIGHT		YELLOW-MIXED		BROWN-MIXED		DARK	
	Male	Female	Male	Female	Male	Female	Male	Female
Smooth-striated	10.7	14.7	9.5	23.4	42.0	56.0	66.7	83.7
Eroded	2.1	2.9	4.8	8.5	16.1	14.0	22.2	7.0
Cryptose	31.9	20.6	33.3	17.0	22.5	12.0	7.4	7.0
Ridged	29.8	26.5	33.3	29.8	16.2	12.0	..	2.3
Scalloped	25.5	35.3	19.1	21.3	3.2	6.0	3.7	..
No. of cases	47	34	21	47	31	50	27	43

structure steadily increases with increasing pigmentation; probably even more than indicated, since the smooth irides recorded in Light eyes, possibly most of those recorded in Yellow-Mixed eyes, are actually highly atrophied types analogous to scalloped. The principal shift from ridged and scalloped (the atrophied flat types) to smooth is between Yellow-Mixed and Brown-Mixed color types. This demarcation may not be too precise, since it is in fact harder to distinguish scalloped and smooth, the two extremes, which are both fairly

flat in contour, from the intermediate cryptose type, especially where the structure is camouflaged by variegated coloring. The constant sex difference in structure, evident in all color types, should be noted in passing as a matter which will require separate consideration.

Because of the interrelations of structure and color, the analysis of structure considered apart from color is ambiguous and is not given here. Table 7 gives an analysis based on division into the four main color types, with subdivision of structure into cryptose-plus-eroded versus all other structure types. In all categories of color the cryptose-eroded group shows a proportionally higher frequency of siblings of identical type as compared with those of the same color, but different structure. In cases where the color is different, the sibling likeness in structure is less clear; though the positive association of Light cryptose-eroded and Dark cryptose-eroded eyes shows

TABLE 7

Sibling comparisons of eye structure, divided by color.

EYE COLOR AND STRUCTURE OF SIBLINGS IN PER CENT	EYE COLOR AND STRUCTURE OF INDIVIDUALS: Light		Yellow-Mixed		Brown-Mixed		Dark		
	Cryptose-eroded	Other	Cryptose-eroded	Other	Cryptose-eroded	Other	Cryptose-eroded	Other	Total
Light:									
Cryptose-eroded	19.4	13.7	8.8	10.2	10.6	8.6	12.7	1.3	10.0
Other	24.7	38.1	14.7	18.2	22.7	9.1	12.7	3.7	18.0
Yellow-Mixed:									
Cryptose-eroded	6.5	5.9	20.6	16.1	2.7	..	10.9	5.0	7.3
Other	15.1	14.9	32.3	18.9	9.3	7.4	21.8	11.2	14.7
Brown-Mixed:									
Cryptose-eroded	8.6	10.1	2.9	5.1	10.7	7.4	16.4	6.8	8.1
Other	16.1	9.5	..	9.5	17.3	36.6	7.3	31.0	18.8
Dark:									
Cryptose-eroded	7.5	4.2	8.8	8.8	12.0	2.3	10.9	2.5	5.9
Other	2.1	3.6	11.8	13.1	14.7	28.6	7.3	38.5	17.2
No. of cases	93	168	68	137	75	175	55	161	932

that the structure designation is not seriously invalidated by color difference. In the Light and Yellow-Mixed types the genetic distinction between cryptose-eroded and the other types of structure is not very strong. In the Brown-Mixed and Dark eyes, however, the distinction is clear. The heavily pigmented cryptose-eroded eyes and the heavily pigmented smooth-surfaced eyes tend not to appear in the same families.

The difference between the structural types is most striking in the Dark group. The Dark cryptose-eroded eyes and the Dark smooth-surfaced eyes show entirely different familial associations. The average family of an individual with Dark cryptose or eroded eyes shows 58% Light or Yellow-Mixed eyes, 27% Brown-Mixed or Dark cryptose-eroded eyes, and only 15% (less than half the population frequency) of smooth-surfaced Brown-Mixed and Dark eyes. The Dark smooth-surfaced eyes, in contrast, occur in families in which Brown-Mixed and Dark eyes of their own structural type predominate to the extent of 69%. The division according to structure appears to divide the Dark eyes into two groups which are genetically independent of one another. In the Brown-Mixed eyes the same phenomenon appears, though less clearly; probably because the Brown-Mixed eyes contain an appreciable number of ridged and scalloped types which in this tabulation are combined with the true smooth type. It should be noted that the association of the heavily pigmented cryptose-eroded types with lighter types of eye includes both structural types of the lighter eyes; and that the heavily pigmented smooth-surfaced eyes are no more related to the lighter non-cryptose eyes than to the lighter cryptose-eroded group. The smooth-surfaced Brown-Mixed and Dark eyes apparently constitute a separate entity distinct from all other types. The cryptose-eroded Brown-Mixed and Dark eyes, on the other hand, occur typically in sporadic individuals of predominantly light-eyed families. They constitute a rare variant of a large class of more or less atrophied and usually rather depigmented irides. The lack of sibling association between the different structural types of the darker eyes shows that they do not owe

their density of pigmentation to the same factors. The rarity of the Dark cryptose-eroded eye indicates that it differs from the Light and Yellow-Mixed eyes, with which it shares some evident common determination, by modifying factors which are recessive; this may be the role of the comparatively rare sex-linked recessive "Dark." One can only hope that the widely advertised theory of the Mendelian dominance of all "brown" eyes has not resulted in the breaking up of any homes.

SEX-LINKAGE OF IRIS STRUCTURE

The first tabulation of the data on iris structure showed 12% more cryptose and eroded eyes in males than in females, which suggested that this class might be a sex-linked recessive. There are two possibilities with regard to the dominant, since the two other main structure groups — those in which there is no atrophy of the anterior layer of the iris, and those in which the atrophy has gone beyond the cryptose stage — are evidently not the same genetically. In selecting categories for this analysis the Brown-Mixed and Dark smooth irides were first segregated. The cryptose and eroded eyes, in which the sex difference is clearest, form the critical group for this analysis. The remaining class includes Light and Yellow-Mixed smooth irides together with all ridged and scalloped irides. Some of the latter are Brown-Mixed (though mostly Light Brown-Mixed), only two are Dark. The Brown-Mixed and Dark smooth group is the one which makes up for the difference in respect to cryptose and eroded eyes by an excess of females, but the possibility of constant errors in judgment of structure in the darker eyes makes this uncertain evidence of dominance.

Two tabulations are presented. In the first, one of the two possible dominants (Brown-Mixed and Dark smooth) is eliminated, so that the remaining figures represent the relation of the cryptose-eroded eyes to the "atrophied" group. In this tabulation the total sex difference is only 4% in favor of cryptose-eroded eyes in males; this difference however is confined

to two classes of families — those of cryptose-eroded males and those of non-cryptose-eroded females. In the other two classes the difference is slightly negative. The overall correlation between siblings is not high in any class; as between brothers and sisters there is in fact no correlation at all, all sibling likeness being between siblings of the same sex. This is a plausible result where somewhat ill-defined characters, such as our rough subdivisions of structure, are determined by a sex-linked inheritance.

TABLE 8

Sibling comparisons, iris structure, divided by sex.

A. Cryptose-eroded structure versus ridged, scalloped, and Light and Yellow-Mixed Smooth-striated.

IRIS STRUCTURE, IN PER CENT	SIBLINGS OF MALES, CRYPTOSE-ERODED		SIBLINGS OF FEMALES, CRYPTOSE-ERODED		SIBLINGS OF MALES, RIDGED ETC.		SIBLINGS OF FEMALES, RIDGED ETC.	
	Brothers	Sisters	Brothers	Sisters	Brothers	Sisters	Brothers	Sisters
Cryptose-eroded	51.8	45.0	47.4	49.3	43.3	46.8	49.2	37.5
Ridged, etc.	48.2	55.0	52.6	51.7	56.7	53.2	50.8	62.5
No. of cases	54	60	57	81	60	64	45	31

B. Cryptose-eroded structure versus Brown-Mixed and Dark Smooth-striated.

IRIS STRUCTURE, IN PER CENT	SIBLINGS OF MALES, CRYPTOSE-ERODED		SIBLINGS OF FEMALES, CRYPTOSE-ERODED		SIBLINGS OF MALES, SMOOTH-STRIATED		SIBLINGS OF FEMALES, SMOOTH-STRIATED	
	Brothers	Sisters	Brothers	Sisters	Brothers	Sisters	Brothers	Sisters
Cryptose-eroded	80.0	73.0	90.0	67.8	15.6	9.7	26.3	18.4
Smooth-striated	20.0	27.0	10.0	32.2	84.4	90.3	73.7	81.6
No. of cases	35	37	30	59	45	31	38	103

In the second tabulation the "atrophied" types of iris are removed from consideration, so that the table represents the relation of the cryptose-eroded group to the Brown-Mixed and Dark smooth class only. Here there is a sex difference of 10% in frequency of cryptose-eroded eyes. This difference however is not distributed according to the laws of sex-linkage; the outstanding sex difference (22%, the next in rank

being 8%) is in the class of siblings of supposedly recessive females, where the sex difference should be absent or at a minimum. The all-over sibling likeness is high in this tabulation, as compared with the last, in accord with the strong genetic distinctiveness of the heavily pigmented smooth iris, but this likeness is fully as high between siblings of opposite sex as between those of the same sex. The most obvious indication of sex-linkage — a general sex difference in the total population — does not in this case seem to indicate the true allelomorph of the recessive cryptose-eroded type. It is interesting that the Brown-Mixed and Dark smooth-eyed males have a higher incidence of like siblings of both sexes than do the corresponding females. The females may represent a less pure group; including, because of the female tendency to fewer cryptose-eroded and more Brown-Mixed and Dark eyes, a larger proportion of darker eyes of basically scalloped structure which were mistakenly recorded as smooth. This would account for the apparent excess of the darker smooth irides in women, though the true sex-difference lay in the "atrophied", i.e., the ridged and scalloped category.

A cross-check may be made on the sex-linkage of color and structure of the iris by testing the two for linkage to one another. This linkage can be considered independently of sex, since the fact that the two determining genes are both located in the X-chromosome will affect their joint inheritance in siblings of the same sex, who may differ in respect to which one of the mother's two X-chromosomes they received. A difference between two siblings in respect to one of a pair of genetically linked traits does not of course necessitate a difference in the linked trait. The combination of genes in any parental chromosome is affected by chance and the gene-frequencies involved, and two parental chromosomes which differ in respect to one gene may be the same in respect to another. The fact that two siblings differ in the first trait merely indicates that they have not received the same parental chromosomes; this means that as far as any resemblance in a second, linked, trait is concerned, they might as well not have had the

same parents. Similarity in the second trait may appear, of course, as often as it might in unrelated individuals. It is always necessary to discount any general correlation of two traits in the population, since this may indicate the action of a single gene which affects both traits in part. Such a correlation may result from a very persistent linkage dating from a time when the ancestral lines of the various families in the present population were arising from the same individuals. The possibility of chromosome breakage in any one generation, however, which will affect linkage within the family to a lesser extent, will eventually break down the original linkage patterns. Hence we may proceed on the assumption that a gene for trait A which is linked to a certain gene for trait B in one family is as likely as not to be linked with an allelomorph for trait B in another family.

In tabulation of the linkage of eye color and iris structure the smooth irides have been separated from the ridged and scalloped group in all color categories. There are definite signs of genetic difference here, though there was little alternative to combining them in the series which had to be further subdivided according to sex. For this analysis a separate chance or contingency expectation was made for the expectation of likeness in structure for each combination of colors. The chance frequency of cryptose-eroded × cryptose-eroded pairs in the group Light eyes × Dark eyes, for instance, was calculated on the basis of the frequency of cryptose-eroded type in those Dark eyes which appear as siblings of Light, rather than the frequency in all Dark eyes. In the case cited, this amounts to a considerable difference. Table 9 gives the chance expectation of sibling pairs alike in structural type, as thus calculated for each class of color likeness or difference, as contrasted with the actual occurrence of sibling pairs alike in structural type. The last two lines of the table are the critical ones, they give the data for all those sibling pairs — Light × Yellow-Mixed and Light × Brown-Mixed — in which a difference in the sex-linked color factor is evident; and those pairs in which the two siblings are of

the same type with regard to the sex-linked color factor — either both recessive (Light) or both dominant (Yellow-Mixed or Brown-Mixed). Similarity in structure beyond the amount attributable to chance alone is confined to those sibling pairs in which no difference in respect to the sex-linked color factor is evident (here the excess of like structure in 7.2 times its probable error). In those pairs in which the two siblings

TABLE 9

Evidence of linkage between eye color and iris structure.

COMPOSITION OF SIBLING PAIRS, BY COLOR	NUMBER OF SIBLING PAIRS	NUMBER OF PAIRS HAVING SAME STRUCTURAL TYPE		EXCESS OF CASES OVER EXPECTED NUMBER
		Expected "random" frequency	Actual occurrence	
Light × Light	128	59.1	68	8.9
Light × Yellow-Mixed	55	20.8	24	3.2
Light × Brown-Mixed	56	18.5	16	— 2.5
Light × Dark	22	6.4	7	.6
Yellow-Mixed × Yellow-Mixed	84	28.0	40	12.0
Yellow-Mixed × Brown-Mixed	22	6.1	9	2.9
Yellow-Mixed × Dark	44	11.3	10	— 1.3
Brown-Mixed × Brown-Mixed	98	38.5	58	19.5
Brown-Mixed × Dark	74	37.0	47	10.0
Dark × Dark	76	58.6	68	9.4
Combined groups				
Light × Light, and Yellow- or Brown-Mixed × Yellow- or Brown-Mixed	332	131.7 ± 6.0	175	43.3
Light × Yellow- or Brown-Mixed	111	39.3 ± 3.4	40	.7

differ in respect to the sex-linked color factor, the excess of likeness in structure over random expectation is 0.7 cases — hardly worthy of a comparison with its measure of variability. The linkage of structure and color is actually better demonstrated than the linkage of structure with sex.

DOMINANCE

Almost nothing has been said of dominance in the foregoing discussion. This is because dominance is, all things considered, a most difficult thing to define in the present data.

Mendelian dominance has a certain dramatic value, as the means by which the geneticist, having placed two dominant rabbits in a hat, may subsequently draw forth an unexpectedly different, recessive, offspring for the demonstration of genetic segregation. But essentially dominance connotes simply the outward indistinguishability of the heterozgous type from one of the homozygous ones. It follows that in traits of considerable variability we may create "dominance" by our own ineptness. Presented with a hypothetical determination of hair color, for instance, in which blond hair represented one homozygous type, medium brown the heterozygote, and dark brown the second homozygous type, we may choose to divide the data into two classes, blond versus medium-to-dark-brown, because this division happens to seem appropriate to us. We will then inevitably find that "brown" hair is dominant by every possible test, not because the heterozygote is truly indistinguishable from one of the homozygotes, but because we have chosen to disregard the distinction. Conversely, the more carefully we subdivide the data, the less likely "dominance" is to appear.

In considering dominance — such as it may be — two criteria may be invoked. The first, stated simply in pedigree form, is that the dominant trait can appear only in individuals one of whose parents also shows the dominant type, since the dominant gene by definition cannot be concealed by an individual who carries it. The recessive trait may appear, through recombination, in the offspring of parents neither of whom appears recessive. The second criterion pertains to the sibling group; it is that in sibling groups in which the dominant appears at all, it will be found in the long run to comprise at least half of all individuals in those groups. Mixed families — those in which both dominant and recessive appear — fall, according to their parentage, into two groups; those in which the offspring are three-quarters dominant and those in which they are half dominant; the dominant trait appears as a minority in sibling groups only by fluctuation of sampling, which of course is considerable in single families. The

trait which appears consistently as a minority is marked as recessive. (The two criteria are related by common sense as well as by genetical deduction. No type can appear in less than half of the parents of a family, since there are only two parents. If it appeared in the offspring only when one of the parents showed it, and characteristically appeared as a minority, it would soon progress to extinction.)

The method of sibling pairs is not altogether satisfactory for identifying dominants and recessives, since the frequency of sibling repetition — i.e., of A siblings of a type A — includes not only cases in mixed families, but those in families which produce siblings of only one type. So, although the minimum amount of sibling repetition starts at 25% for simple recessives and at 50% for simple dominants, where the trait under consideration is rare, the distinction disappears as the population frequency of the trait approaches 50%. This is due to the frequency of recessive × recessive sibling pairs from pure recessive families. A clearer delineation of dominance may be obtained by using units of three siblings, instead of pairs. The statistics of the "sibling triad" need not be gone into fully here. Suffice it to say that for purposes of determining dominance we need only be concerned with "mixed" triads — those in which the three siblings are not all of the same type. Where two phenotypes A and B are involved, the mixed triads are those which consist either of two siblings of type A and one of type B, or of one sibling of type A and two of type B. These triads of course can arise only in mixed families, since they have as a base an A × B sibling pair; whether the third sibling who completes the triad is A or B depends on the composition of the mixed families from which the A × B sibling pairs are drawn. The ratio of A × A × B triads to A × B × B triads, in fact, will in the long run represent the average ratio of A to B phenotypes in the mixed families.[3] This procedure affords us the

[3] Where the probability of occurrence of an A sibling is a, and the probability of occurrence of a B sibling is b, the frequency of the triad combinations is determined by the expansion of $(a + b)^3$. The ratio of AAB triads to ABB triads is $\frac{3\,a^2\,b}{3\,a\,b^2} = \frac{a}{b}$.

most direct approach to determining the majority and minority types in mixed families, and thus relative dominance and recessiveness of any two types.

Table 10 gives a rough orientation of the principal eye color types in respect to dominance. The Dark smooth iris, together with the cognate Brown-Mixed smooth type, shows a definite numerical predominance in the mixed families of the

TABLE 10

Composition of sibling triads (extracts).

EYE COLOR			
First sibling	Second sibling	Third sibling	No. of cases
Dark smooth-striated	Light, Yellow-Mixed, Brown-Mixed cryptose-eroded or Dark cryptose-eroded	Dark or Brown-Mixed smooth-striated	42
		Other	23
Dark smooth-striated	Brown-Mixed smooth-striated	Dark smooth-striated..	28
		Brown-Mixed-smooth-striated	38
Light	Non-Light	Light	96
		Non-Light	109
Pure Light	Non-Light	Pure Light	37
		Non-Light	52
Yellow-Mixed	Brown-Mixed	Yellow-Mixed	1
		Brown-Mixed	6
Dark cryptose-eroded	Yellow-Mixed, or Brown-Mixed cryptose-eroded	Dark cryptose-eroded	7
		Yellow-Mixed, or Brown-Mixed cryptose-eroded	19

series. As between Dark smooth and Brown-Mixed smooth types, the darker eyes are if anything recessive. (It should be remembered that nearly all these eyes are "brown" in the popular sense of the term.) The mixed triads of Light versus non-Light show only a slight preponderance of non-Light; this ratio is much exaggerated if the Near Light eyes are counted out. Since Light is definitely recessive in respect to sex-linkage, and should be a minority type in the mixed families, we may suspect that the Near Light eyes confuse the

issue, some of them being actually variants of a mixed type. Within the intermediate pigmentation group the small numbers of cases involved give no clear evidence; the indications are that Yellow-Mixed is recessive to Brown-Mixed, and that the rare Dark cryptose-eroded eye is recessive to both Yellow-Mixed and Brown-Mixed cryptose-eroded types.

CONCLUSIONS

Although the varieties of human eye color are complicated and have been made more so by the introduction of criteria of iris structure, they can be explained in general as the result of various combinations of six factors or factor groups.

The first factor, apparently dominant, produces an iris which has a completely developed anterior vessel layer and is more or less heavily pigmented. Its structure designation is smooth, its color designation Dark or Brown-Mixed. In the absence of this factor the iris is more or less atrophied in respect to the anterior layer, and usually more or less depigmented, except in the extreme posterior or retinal layer, which has not been considered at all, as it is concerned only with variation in the shade of blue of the iris.

The second factor — or, quite possibly, series of similarly acting genes — determines the difference between the two color phases, Dark and Brown-Mixed, of the smooth pigmented iris.

The third factor, a sex-linked dominant, is the principal determiner of eye color outside of the smooth pigmented class. It produces a non-Light eye, partially pigmented or rarely Dark, which may be distinguished, even in its darker phases, from the smooth pigmented eye, by its structure. In the absence of this factor the eye is Light.

The fourth factor, also a sex-linked dominant, produces an advanced degree of atrophy of the anterior vessel layer, so that the structural detail of the iris is of ridged or scalloped type. In the absence of this factor the atrophy is arrested at the intermediate, cryptose or eroded stage. There are probably some unidentified modifying factors also active in de-

termining the degree of atrophy, as the picture of sex-linkage is not as clear as might be desired.

The fifth factor, more probably dominant than recessive, renders the pigmented areas in a mixed eye brown rather than yellow. This factor also acts to produce a very slight pigmentation in a Light eye. In the absence of this factor the mixed eye is Yellow-Mixed and the Light eye appears completely innocent of pigmentation. It may be, of course, that the very small pigmented area, such as characterizes the Near Light eye, is merely beyond ordinary observation if it is also pale in color.

TABLE 11

Genetic determination of various types of iris.

COLOR	STRUCTURE	FORMULA
Brown-Mixed	Smooth or striated	AB
Dark	Smooth or striated	Ab
Pure Light	Scalloped, ridged, smooth or striated	acDe
Pure Light	Cryptose or eroded	acde
Near Light	Scalloped, ridged, smooth or striated	acDE
Near Light	Cryptose or eroded	acde
Yellow-Mixed	Scalloped, ridged, smooth or striated	aCDeF
Yellow-Mixed	Cryptose or eroded	aCDeF
Brown-Mixed	Ridged or scalloped	aCDEF
Brown-Mixed	Cryptose or eroded	aCdEF
Dark	Ridged or scalloped	aCDf
Dark	Cryptose or eroded	aCdf

The sixth factor, a recessive, is responsible for the rare cases of truly Dark eyes which are not of smooth structure. These cases are extreme variations of the atrophied iris, and are unrelated to the smooth Dark eyes.

Table 11 gives symbolic formulae for the genetic determination of the various types of iris. These are not presented in full conventional genetic form, though factors believed to be dominant are represented by capital letters, their allelomorphs by small letters. Heterozygotes are not represented because

of the uncertainties of dominance; presumably "A" includes Aa as well as AA, but if the reader chooses to disagree on the matter of dominance, he may assume that Aa is included under "a." The certain fact is that "A" and "a" represent a definite difference of genotype. Where factors are ineffective in certain combinations because of the presence or absence of other factors, they are not indicated. The number of factors which any two types have in common serves as an index of their likelihood of occurring both in the same sibling group, except insofar as the relation is disturbed by the linkage of the C and D factors.

Certain phenomena remain unexplained. One is the number of sibling-pairs Yellow-Mixed × Dark. In the formulae of table 11 nothing will be found to indicate any common factor between these two which both do not share with Brown-Mixed; yet Yellow-Mixed and Brown-Mixed occur together with a rarity which seems to exceed the bounds of a mere one-factor difference. Are there perhaps two factors, one for yellow pigment and one for brown pigment, which when combined in heterozygous form add up to pure brown? If this worked out strictly, however, Dark, as the hetrozygous class, ought to be relatively larger in numbers than it is. There may be some significance in the fact that Yellow-Mixed and Dark are both characterized by a low degree of contrast between the lighter and darker parts of the iris; this is the only stretch of the imagination by which they can be said to both differ in the same way from Brown-Mixed.

Another anomaly encountered is the complete lack of genetic discrimination between Light Brown-Mixed and Medium Brown-Mixed. Even if there were several independent factors determining the difference, some genetic distinction should be possible. Yet it seems unlikely that the difference between the two is entirely non-hereditary.

What is the true picture of correlation between structure and color? This is largely explained by the establishment of the smooth-pigmented class which includes many Brown-

Mixed eyes and an even larger proportion of Dark eyes. But this does not explain the difference in proportion of types other than smooth as between Brown-Mixed and Dark. Partly this may be due to handicaps of observation and a bias towards making judgments of "smooth" and "eroded" when in doubt about a Dark eye. But, since the deeper layers of the eye tend to be less pigmented than the superficial ones, increasing atrophy may tend to shift the color from Dark to Brown-Mixed. Perhaps only a tremendous endowment of pigment makes it possible for an eye to be ridged or scalloped in structure and still be pure brown — an occurrence only recorded in two cases out of three hundred.

These conclusions are not fully satisfying from some points of view. They certainly do not satisfy any desire we might have had for an extremely simple system of eye color determination. The complications produced by the very considerable importance of structure to color inheritance, especially in the Dark eyes, raises unanswerable questions in the interpretation of data already recorded, or which may be recorded in the future by observers who, quite excusably, may have difficulty in agreeing on a structure classification. However, physical anthropology has so far survived the migraine of observational inconsistencies without serious impairment of its vigor. The present data offer no encouragement to the offering of popularized versions whereby the man in the street may predict the appearance of his offspring, or to any legal use of anthropological genetics. It would be unwise to say of any parent-child relation in respect to eye color that it was more than unusual and interesting, even if unexpected. Those who wish their houses kept in order had best attend to the job themselves as best they can, and not expect somatological experts to pass on the legitimacy of their heirs. The only immediate practical value to which any of these data might be put is the determination (in terms of probability only) of whether normal females are carriers of sex-linked defects which are known to be present in their families. Under favor-

able conditions a sex-linked recessive might be traced by means of one of the dominant sex-linked traits of the iris.

The limited scope of the present investigation leaves the racial differences in eye color out of consideration. It is altogether possible that even in white groups of other stock some of the factors important in the present population may be inconsiderable, and that factors absent or not detected in the present series may appear. In the case of descendants of racial crosses factors may appear which are unknown in white populations, and of no visible effect in their original genetic environment, but which present totally novel phenotypes in the hybrid population. There is no prediction of what may be masked by a dominant factor in a pure population. The only racial sorting which could be made in the present series was the isolation of an Irish-American and a German-American group, neither one very different from the total or, for that matter, of pure stock. Both show more Light eyes than the total; but in the Irish-American group this difference is accompanied by an excess of Brown-Mixed and Dark smooth irides, with a shortage of the sex-linked dominant Mixed types and a corresponding degradation of the sex difference in eye color; while in the German-American group the shortage is of the smooth-pigmented types, with the Yellow-Mixed eyes far in excess. Though this cannot be taken as an adequate reflection of the true racial difference, it serves to show what might very well appear in different racial groups. Any discrepancy between different series as regards sex difference in eye color, or as regards the apparent dominance of brown eyes, need not be regarded as indicative of inconsistent or inadequate observation. Such discrepancies may perhaps be legitimately due to difference in the factors involved, even though the general range of eye color may be the same. Hence the present study is presented, not simply as an analysis of factors present in a certain limited group, but as an incentive to the use of open imagination in the interpretation of data which may not fit its genetic interpretation.

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CONGENITAL LOSS OF TEETH.— Accident alone cannot account for the congenital absence of teeth. If that were true, all tooth germs should be affected with equal frequency. We have ample evidence that this does not occur. Certain types of teeth are seldom congenitally absent. Others, namely the third molars, upper second incisors, second premolars, and to a lesser extent lower first incisors, are frequently missing. This pattern occurs with a regularity which suggests an orderly process associated with the congenital loss of the teeth.

The factor responsible for the congenital absence of one type of tooth will probably explain most of the absences of the other types as well. Second premolars, which are in the midportion of the arches quite removed from anatomical structures associated with the incisors or third molars, are missing almost as frequently, if not as frequently, as the upper second incisors. It seems probable, therefore, that the factor responsible for the congenital loss of teeth controls the development of the dental buds, possibly the rate of development, regardless of the position in the arch. Certain buds are more likely to be affected by this modified development that are other buds. — Clarence P. Oliver, Peter J. Brekhus, and George Montelius. Study of congenitally missing second premolars and space factors in the arches. J. Dent. Res., vol. 24, 1945, pp. 217–221.

ANALYSIS OF BODY BUILD PHOTOGRAPHS OF 175 COLLEGE WOMEN

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THREE TEXT FIGURES AND THREE PLATES

INTRODUCTION

The routine physical examinations and the daily dispensary data of a college medical office produce a wealth of information concerning the young adult. Dr. Reginald Fitz in discussing the recording of such material referred to it as "documented clinical evidence." Viewed from the standpoint of urgency and immediacy, much of this record appears meaningless. Judged from the obvious need to develop a base line of knowledge about the average person, one can visualize great benefit from the proper analysis of this accumulated data.

The oft repeated complaint of the college student that she is tired, not sick, requires penetrating study. Physical examination and laboratory tests such as hemoglobin value, urinalysis, and chest x-ray seldom reveal gross abnormality. A study of fatigue in college women resolves itself into a study of college women. We have begun with the description of the body, but it is obvious that to lead to fruitful recommendations to remedy fatigue, much more must be known about each "tired" girl. The description of her biological potentialities takes on dynamic meaning only when correlated with the other areas of her life and personality.

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Studies have been made of possible correlations of body build with other considerations such as personality (Sheldon, '42), physical fitness (Seltzer and Brouha, '43), disease (Draper, Dupertuis and Caughey, '44). However, purely descriptive and utilizable material on the so-called normal young woman is meager except for standard anthropometric measurements. The few descriptive German series in the literature offer definite limitations. Makarow ('32) works out an elaborate system of sex differences from a study of 74 females. He represents fat and muscular individuals of both sexes but illustrates no thin persons in his study. Jaensch ('35) is working exclusively with athletes in the physical educational setting. Though Skerlj ('38) has 192 women, they are of an age range from 17 to 35 and here the athletes seem to be practically nonexistent and the plump contour prevails. Therefore the eight "types" he delineates refer to the various placing and degrees of fat. He notes the presence of leptosome (thin) and eurysome (wide) body builds in the eight "form-types" of fat distribution. The need of a normal female series is evident.

This fact is emphasized by the current interest in androgyny (Draper, '41), gynandromorphy (Sheldon, '40), or masculinity (Seltzer and Brouha, '43). It seems especially imperative to the authors of the present study that any system of body classification based on sex differences should arise from factual morphological data on both sexes with comparable groups of normal individuals. To describe a "weak masculine" or "feminine" type of individual when, to our knowledge, no large series of normal females is available for comparative study is a hazardous undertaking. It is also well to bear in mind that Mead ('35) has suggested that certain aspects of masculinity and femininity may be differently defined in different cultures.

Morphological correlates of androgen and estrogen incidence would be of interest. Many studies offer tantalizing hints from the field of endocrinology. (Klinefelter, Reifenstein and Albright, '42), (Kenyon, Gallagher, Peterson, Dorf-

man and Koch, '37), (Lukens and Palmer, '40), (Young, '37). Future studies will probably correlate observable morphological variations with hormone activity and sexual physiology. However, morphological description must be clearly presented before it can correlate with anything.

Therefore the present study concentrates its attention on the development of a tool for morphological description. The method used is based on features taken directly from Sheldon ('40). We have used three variables which are exactly synonymous with Sheldon's descriptions of endomorphy (Dupertuis, '44, soft roundness), mesomorphy (Dupertuis, muscular solidity), and ectomorphy (Dupertuis, linearity — delicacy). In selecting the particular criteria for observation, secondary sexual characteristics have been omitted. This produces a basic somatotype for either sex with which particular sexual or other characteristics can be correlated to expand any given investigation.

We have tried to systematize the making of the somatotype judgment by the tabulation method described below. It has been our intention to try to obviate to some extent the following weaknesses discovered by Shaplin ('42) when he tried to use the Sheldon system as it now stands:

1. Lack of standardization of values.
2. Problem of setting up personal standards through observational experience.
3. Need for means of body build description without photographs when desirable.
4. Problems of stature and gross size.

METHOD

The body has been divided into five regions:

Region I — Head, face, neck
Region II — Thoracic trunk
Region III — Arms, shoulders, hands
Region IV — Abdominal trunk
Region V — Legs and feet

For each region, seven specific observable points (table 1) have been chosen for each of the three variables: endomorphy,

TABLE 1

Region I — Head, face, neck.[1]

ENDO	MESO	ECTO
1. Head large, spherical	1. Head rugged, cubical	1. Head small, slight
2. Face fat (fat cheeks)	2. Face muscled, strong	2. Face thin, puny
3. Face wide: lower $\cong$ upper width	3. Bones heavy, prominent (massive cheekbone, square jaw)	3. Bones delicate
4. Soft round features (blobby nose) (fat cheeks) (small, full lips, ''rosebud'' mouth)	4. Heavy features (large nose) (large, prominent cheekbones) (thick, muscled lips)	4. Small, finely chiseled features (sharp, narrow prominent nose) (cheekbones delicate, visible) (thin lips)
5. Clavicular outline softened Shoulder girdle padded	5. Clavicles heavy, prominent	5. Marked clavicular hollow
6. Short neck	6. Pyramiding of trapezius muscles on sides of neck[2]	6. Long, slender neck
7. Large A–P $\cong$ Trans. diam. neck[3]	7. A–P $<$ Trans. diam. neck[3]	7. Small A–P $\cong$ Trans. diam. neck[3]

[1] Footnotes present explanations in non-technical terminology, directions, or recommended substitutions which will be used in future work. Symbol $\cong$ signifies ''approximately equal to.''

[2] Locate in anterior and posterior views by marked sloping silhouette of trapezius from shoulder to neck.

[3] Shortest photographic diameters are used in making this observation (see Sheldon, p. 54). Approximate measurements on photographs or subjects may be made when observations are doubtful.

TABLE 1 — *(continued)*

Region II — Thoracic trunk.

ENDO	MESO	ECTO
1. Fat, soft roundness (thick front to back-padding of fat)	1. Square, bone-muscle hardness (moderate thickness front to back — muscular)	1. Linearity, fragility (shallow front to back — lack of padding)
2. Soft back	2. Rugged muscling (back and front)	2. Slight, ''thready'' muscles (back and front)
3. Chest base wide	3. Broad, athletic taper (chest wide and tapering to base. Shows usually in both back and front views)	3. Scapulae wing out (kyphic angle, ''shoulder droop'' frequent)[1]
4. Predominance of abdomen (mass) over thorax (mass)	4. Predominance of thoracic mass over abdominal mass (thorax wide at the top)	4. Thorax narrow and longer than abdomen (barrel shaped or straight sides frequent)
5. Wide flare of rib angle[2]	5. Intermediate flare of rib angle[2]	5. Acute rib angle[2]
6. High position of lower ribs[3]	6. Ribs strong, heavy	6. Ribs delicate, prominent
7. Fatty pectoral area	7. Muscular pectoral area	7. Flat, bony pectoral area

[1] See Sheldon, p. 42.

[2] Angle made by ribs with vertebral column and with sternum (see Sheldon, p. 38).

[3] This tends to produce a relatively short rib cage.

TABLE 1 — *(continued)*

Region III — Arms, shoulder, hands.

ENDO	MESO	ECTO
1. Shoulders high, square, soft, sometimes sloping	1. Shoulders rugged, broad	1. Shoulders delicate and/or narrow
2. Proximal arm segments heavy and markedly greater than distal [1]	2. Arm segments solid and evenly proportioned [2]	2. Arms relatively long (distal segments often long) [3]
3. Rounding and ''hamming'' of upper arm	3. Deltoid prominent (distinct silhouette)	3. Weak upper arms
4. Smooth, plump contours	4. Heavy muscular relief Strong forearm thickness $\cong$ upper arm thickness [4]	4. Arms spindly
5. No bony projections	5. Bones large, knuckles and joints prominent	5. Knuckles and joints small
6. Wrists fat, soft	6. Wrists massive, bony	6. Wrists delicate, fragile
7. Small, soft hands	7. Large, rugged hands and fingers	7. Fingers, fragile, long [5]

[1] Upper arm markedly larger and heavier than lower arm.

[2] Both upper and lower arm segments massive and solid.

[4] In checking the series, presence of ''heavy muscular relief'' was determined by measuring the relative forearm and upper arm thicknesses. Lateral view. Midpoint of upper arm. Widest point below elbow. (See Sheldon, p. 56.)

[3] Arms relatively long. Lower arm often longer than upper.

[5] Substitute: The following rewording of this item is suggested: ''Slender hands with long, fragile fingers.'' This might slightly reduce the occurrence of ectomorphic hands.

TABLE 1 — (*continued*)

Region IV — Abdominal trunk.

ENDO	MESO	ECTO
1. Abdomen large, A–P ≅ Transverse diameter (Note minimum photographic diameters at narrowest point of waistline)[1]	1. Abdomen compact, no diffusion of mass	1. Abdomen short, relatively inconspicuous compared to long arms and legs
2. Waist high, faint, wide	2. Waist low — medium width	2. Waist slender, often pinched
3. Abdominal protuberance (abdomen thick)	3. Prominent abdominal musculature but no protuberance	3. Flat, shallow abdomen (may protrude below navel)
4. Fat pads on postero-lateral aspect of upper pelvis[2]	4. Sturdy pelvis[3]	4. Narrow pelvis[4]
5. Prominent fat on upper thigh (projects laterally from buttocks)[5]	5. Firm muscled upper thigh	5. Thin, stringy upper thigh
6. Buttocks soft, round, large	6. Buttocks solid, muscular	6. Buttocks thin, relatively flat
7. Abdominal folds	7. Distinct inguinal line[6]	7. Ant. Sup. Iliac spine visible

[1] See Sheldon, p. 56.

[2] Seen from rear. Resultant ''bump'' in silhouette.

[5] Second ''bump'' in silhouette. Over trochanters.

[3] Substitute: Broad pelvis, sturdy (not due to fat).

[6] Due to muscular rippling at Poupart's ligament.

[4] Substitute: Narrow pelvis, usually light.

TABLE 1 — *(continued)*

Region V — Legs and feet.

ENDO	MESO	ECTO
1. Large A–P $\cong$ Trans. Diam. calves [1]	1. A–P $<$ Trans. Diam. calves	1. Small A–P $\cong$ Trans. Diam. calves
2. Proximal leg segments heavy and markedly greater than distal [2]	2. Leg segments solid and evenly proportioned [3]	2. Legs relatively long
3. Rounding and "hamming" of thighs	3. Heavily muscled thighs [4]	3. Weak thighs
4. Thighs approximate (when heels together) [5]	4. Lateral muscling prominent [6]	4. Space between thighs (when heels together) [7]
5. Pronounced development of outer calf curve	5. Pronounced development of inner gastrocnemius (calf shadow and curving silhouette)	5. Legs spindly
6. Ankles fat	6. Ankles thick, bony	6. Ankles delicate, fragile
7. Small feet [8]	7. Thick heavy feet	7. Toes fragile and (tend to be) long [9]

[1] Measure at widest diam. of calf. See Sheldon, p. 57.

[2] Thighs larger and heavier than calves.

[5] If heels are not together in photograph, check "thighs approximate" when widest space between thighs is approximately equal to or less than space between heels.

[8] Substitute: Small, plump feet.

[3] Explanation: Both upper and lower leg segments massive and solid.

[4] Noted anteriorly. Muscle shadows or pronounced silhouette.

[6] One or more muscle lines (shadows) running up from knee. May be directed towards front or back of leg.

[7] If heels are not together in photograph, check "space between thighs" when widest space between thighs exceeds space between heels.

[9] Substitute: Slender feet with long, fragile toes. (May slightly reduce incidence of ectomorphic feet.)

mesomorphy, and ectomorphy. Where it has been feasible, the traits are tripolar so that only one is checked of the three. In other instances, it is possible to check more than one item to show a situation where some of each factor is observed. Where the presence of the criteria cannot be clearly noted singly or in combination, the item goes unchecked.

A score sheet is set up (fig. 1) and the criteria checked if present. An original count of 1 is allowed each regional subdivision on the basis of Sheldon's custom of considering "some" of each variable present. This results in no "0" ratings. The maximum rating is 7. This means that either 6 or 7 checks receive the 7 rating.[2] The usual total of checks for each region falls from 9 to 12. An occasional 8 total for a region may be allowed where the specific criteria cannot conscientiously be checked as present. However, if the total for the final somatotype does not reach a total of 9 when figured in whole numbers, the somatotype should be rechecked. If there are more than 12 checks for any region, it should be re-examined with the idea that too many items must have received checks in more than one subdivision.

The regional somatotypes are averaged in the following way: Example:

					DYSPLASIA
Region I —	2	6	2		8
Region II —	3	5	1		10
Region III —	2	6	2		10
Region IV —	1	7	3		—
Region V —	2	5	3		28 Total dysplasia
5 |	10	29	11		
	2	5.8	2.2	Decimal somatotype	
	2	6	2	Final somatotype	

[2] It would be possible to produce more 6 ratings and fewer 7 ratings by requiring that a 7 rating be made only when all 7 items are checked. However, the fact that 4 of the 5 regions have to receive a 7 rating to produce a 7 in the final somatotype on the half scale (or 3 of the 5 regions on whole scale scoring) seems to limit the occurrence of 7's. No 117's, 171's or 711's were found in this series and the percentage of 7 ratings is close to that found in Sheldon's series of 4000. Before making 6.6 half ratings 7 for the final summary, our 3% incidence coincided with Sheldon's for 4000. Our final 4% corresponds with his approximate incidence per 1000. (See Sheldon, '40, table 23A, p. 268–9.)

As noted, the .8 is counted as 1 and .2 is dropped. When making ratings on a half scale, the .4 and .6 are counted as ½. On the whole scale rating .4 is dropped and .6 is counted as 1.

Dysplasia is figured as by Sheldon ('40). To get the total differences for the five regions in the three variables, ten matchings are made in each column. I is compared with II, III, IV, and V. The differences are added. II is similarly matched with III, IV, and V; III with IV and V; and IV with V. The resultant sum of the difference, 8, is written with the total differences for columns two and three. These are added to give the total dysplasia.

Discussion of method. A rating based on judgments of increments has purposely been avoided as it may be the cause for much lack of agreement among workers. If disagreement arises as to a given rating or if different raters do not agree, by the tabulation method used in this study the data can be gone over together to see where items have been marked differently. Agreements may be reached or consistent differences allowed for if necessary. At least, the source of difference can be traced and diagnosed. If items are not clearly evident, they are omitted. While the present method will probably show some individual differences between somatotypers or in "border-line" decisions of the same individual, it is believed that it will be less intangible and variable for comparing results of different workers than a 7- or 13-point increment rating scale. Also, it is a method which can be used by people who have only a modicum of training but definite understanding of the particular criteria.

The resultant somatotypes occur on a truly "continuous scale." This is a point Sheldon ('40) has stressed but which strict descriptive adherence to his 76 types tends to contradict. In discussing the 76 types, Sheldon writes:

> . . . perhaps no living physique is a perfect example of a somatotype. The somatotype derives from an average of tendencies. (p. 141)

This average of tendencies will be recorded by the present method whereas formerly the individual had to be forced into

one of the 76 defined boxes. Naturally, the present continuum of somatotypes can be broken into as many sections as one wishes.

Sheldon also calls attention to the fact that

> . . . we shall expect to find within the same somatotype examples which differ quite markedly in detail . . .
>
> . . . a few physiques (about three or four in a hundred) turn out to be "bull's-eye" somatotypes, but this does not mean that two such physiques having the same somatotype are in any sense absolutely alike. They are only relatively alike . . .

The present method produces a new body of data for interpretive purposes from the incidences of the specific criteria. As individuals display the presence of the same observable points, they will fall into "syndrome groups." These may comprise only their own or neighboring somatotype clusters or show similar regional incidences throughout a large group of somatotypes. This will not be due to any "forcing" on the part of the somatotyper, but will simply appear in the analysis of the recorded observations. Symptom syndromes have proven useful in describing diseases where the picture is complex and the syndrome concept may be equally useful in describing morphological constellations.

The method described thus far will be helpful, we believe, in overcoming the two difficulties noted by Shaplin: lack of standardization of values and the problem of setting up personal standards through observational experience. Somatotyping without photographs when necessary can be carried out by making the present standard set of observations on the living. The diameter measurements can be estimated on the living when necessary and many morphological items can be checked more easily on the actual subject. The weakness of not having a photograph is that it is not available for later checking and comparisons with other photographs. The ideal method may be to take a picture for purposes of record and later checking and make observations on the subject at the

time the picture is taken. The 35 triple criteria can be checked in from 20 minutes to ½ an hour.

In dealing with problems of stature and gross size, height and weight may be recorded in columns near the somatotype rating on the score sheet (fig. 1). Other gross anthropometric measurements desired for a particular investigation may be added in subsequent columns. This array of data, plus age for each subject, will add new meaning to anthropometry as it unites itself with the coincident description of soft parts contained in the somatotype observations. Also, as series of somatotypes are correlated with gross body measurements, there may develop small, medium, and large ranges for each somatotype. The elaboration of anthropometric data will naturally depend on the scope of the investigation.

RESULTS

Comparative dominance of somatotype variables. The chart (fig. 2) shows the percentage incidence of predominance in the three variables and the percentage falling in the residual group who combine moderate amounts of all three variables. These groupings have been made by combining as predominantly representative of each variable all the somatotypes showing 7, 6, or 5 ratings. The group of moderate mixtures have ratings of 4 or less in all three variables (table 2).

The college women are compared with Sheldon's college men, with 1,000 Harvard men (Dupertuis, unpublished), and with a group of women students whose somatotypes were estimated by Sheldon from 2,500 bromide silhouettes. Sheldon claims no accuracy for this estimate as the presence of fat versus muscular development and determination of bony structure were difficult to gauge from the silhouettes. Nevertheless, the results are surprisingly close to our distribution. A larger per cent have been rated high in the first variable. This leaves an appreciably smaller number for the group of moderate mixtures. The ecto number is almost the same as the college women. This quality would be easier to estimate from the body outline.

SAMPLE SCORE SHEET

NO.	AGE	SOMATOTYPE	DYS.°	WGT.	HGT.	OTHER DATA
578	20	2.4-2.8-5.4 (2 1/2 - 3 - 5 1/2)	40			
		2 3 5 (146,227,225,424,345)				

REGION I																				
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
								✓		✓		✓		✓	✓		✓	✓	✓	
						1							4							6

REGION II																				
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
						✓				✓				✓		✓	✓	✓	✓	✓
						2							2							7

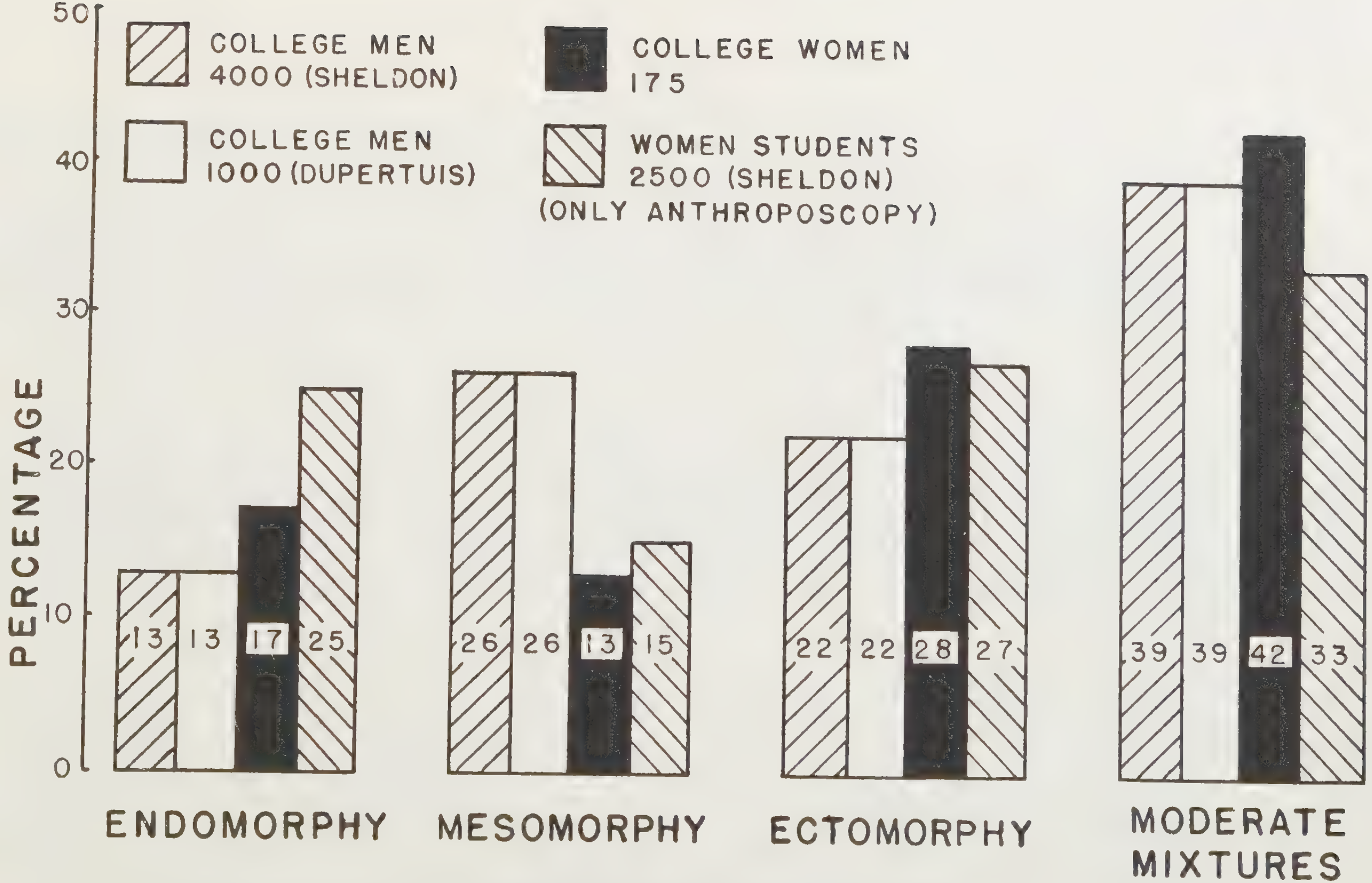
REGION III																				
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
		✓					✓							✓	✓			✓		✓
						2							2							5

REGION IV																				
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
			✓	✓	✓							✓			✓	✓				✓
						4							2							4

REGION V																				
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
		✓	✓							✓	✓	✓		✓	✓				✓	✓
						3							4							5

°TOTAL DYSPLASIA

Figure 1



COMPARATIVE DOMINANCE OF SOMATOTYPE VARIABLES

Figure 2

TABLE 2

Incidence of somatotypes.

SOMATOTYPE	INCIDENCE 175	MEAN HEIGHT	MEAN WEIGHT	MEAN HT./ $\sqrt[3]{}$ WT.	RANGE HT./ $\sqrt[3]{}$ WT.
		Inches	*Pounds*		
126	5	64.5	106.4	13.6	13.1–13.9
127	3	67.5	114.3	13.9	13.4–14.2
136	3	64.1	109.7	13.4	13.3–13.5
146	1	68.9	128.5	13.7	13.7
163	1	65.0	126.0	13.0	13.0
225	6	64.5	114.9	13.3	13.0–13.6
226	8	65.8	117.0	13.5	13.2–13.9
234	4	62.6	107.5	13.2	12.7–13.4
235	10	66.2	124.9	13.3	13.1–13.5
236	5	65.3	116.1	13.4	13.2–13.5
243	2	64.1	127.5	12.8	12.6–12.9
244	4	65.7	123.7	13.2	13.0–13.4
245	3	67.8	133.7	13.2	13.0–13.3
252	1	62.5	115.3	12.8	12.8
253	2	64.9	123.9	13.0	13.0–13.0
254	1	65.2	116.0	13.4	13.4
261	1	64.5	128.0	12.8	12.8
262	3	63.3	125.3	12.7	12.4–13.0
263	1	68.5	144.3	13.1	13.1
271	2	61.9	119.3	12.6	12.5–12.7
272	2	66.5	142.8	12.8	12.5–12.9
324	2	63.5	122.6	12.8	12.7–12.9
325	2	66.2	133.3	13.0	12.7–13.3
333	2	65.3	118.6	13.3	13.0–13.6
334	10	64.9	126.9	12.9	12.5–13.2
335	3	65.5	123.0	13.2	13.0–13.5
342	3	62.7	120.3	12.7	12.2–13.4
343	15	65.1	131.0	12.8	12.5–13.1
344	5	65.1	129.0	12.9	12.8–13.0
352	2	63.0	122.9	12.7	12.7–12.7
353	2	65.2	134.7	12.8	12.4–13.1
423	2	64.8	131.2	12.8	12.6–12.9
424	3	63.9	127.9	12.7	12.6–12.8
432	6	64.0	139.3	12.3	11.9–12.7
433	2	64.4	129.4	12.75	12.7–12.8
442	8	64.4	138.1	12.5	11.8–13.0
443	6	63.1	125.8	12.6	12.5–12.8
451	1	64.4	130.5	12.7	12.7
452	2	65.2	141.2	12.6	12.3–12.8
453	1	67.9	146.5	12.9	12.9
522	1	63.5	133.0	12.5	12.5
523	1	62.6	117.6	12.8	12.8
531	5	63.8	144.2	12.2	11.8–12.5
532	5	64.2	139.6	12.4	11.9–12.5
533	1	63.5	141.1	12.2	12.2
541	3	65.0	152.8	12.2	11.9–12.4
542	2	65.7	147.5	12.45	12.4–12.5
621	4	64.5	144.2	12.3	11.8–12.8
622	3	66.4	160.3	12.2	12.0–12.5
631	2	65.6	167.2	11.95	11.7–12.2
632	2	64.7	162.3	11.85	11.8–11.9
641	1	62.0	152.3	11.6	11.6

As to the comparison with the college men, it is interesting to note that the men have less of Variables I and III and higher incidence of Variable II.

Distribution of Variables. The distribution of variables is shown compared to those given by Sheldon for his 4,000 men and 2,500 women (fig. 3). The mean for the college women is slightly lower than the mean for college men in Variables I and III and appreciably lower in Variable II. This agrees with the "expected" greater muscular development in men.

The mean for college women falls below the estimate for women in Variable I, is slightly higher in II, and approximately the same in III. Due to the difficulties in somatotyping the bromide silhouettes, too much weight cannot be attached to these comparisons.

It is of interest to note that, while the means for the third variable are approximately the same for the three groups, the shape of the curve for the college women shows that they have more extremes and fewer middle ratings in ectomorphy.

Comparison of incidence of somatotypes — Sheldon men and college women. Sheldon ('40, pp. 268–269) presents a table showing the incidences of his 76 somatotypes among his 4,000 college men. With this list he gives data on height, weight, and height over the cube root of the weight. A similar table for our study is given (table 2). It will be noted that, when figured in whole numbers, we find the following combinations not included in Sheldon's list: 146, 234, 243, 272, 324, 333, 342, 423, 432, 531.

As the present method is an attempt to make somatotyping a more objective procedure and on the basis of a continuum rather than "types," it seems that we must be prepared to "accept" the logical variations in the results of our observations. None of the ratings arrived at above represent "new" body builds but formerly were put into one of the 76 categories according to the strict Sheldon system or, as also possible with the present method, are more closely described by use of the half scale (see section on method, p. 46). Six of the ten combinations above have resulted from raising ½ ratings.

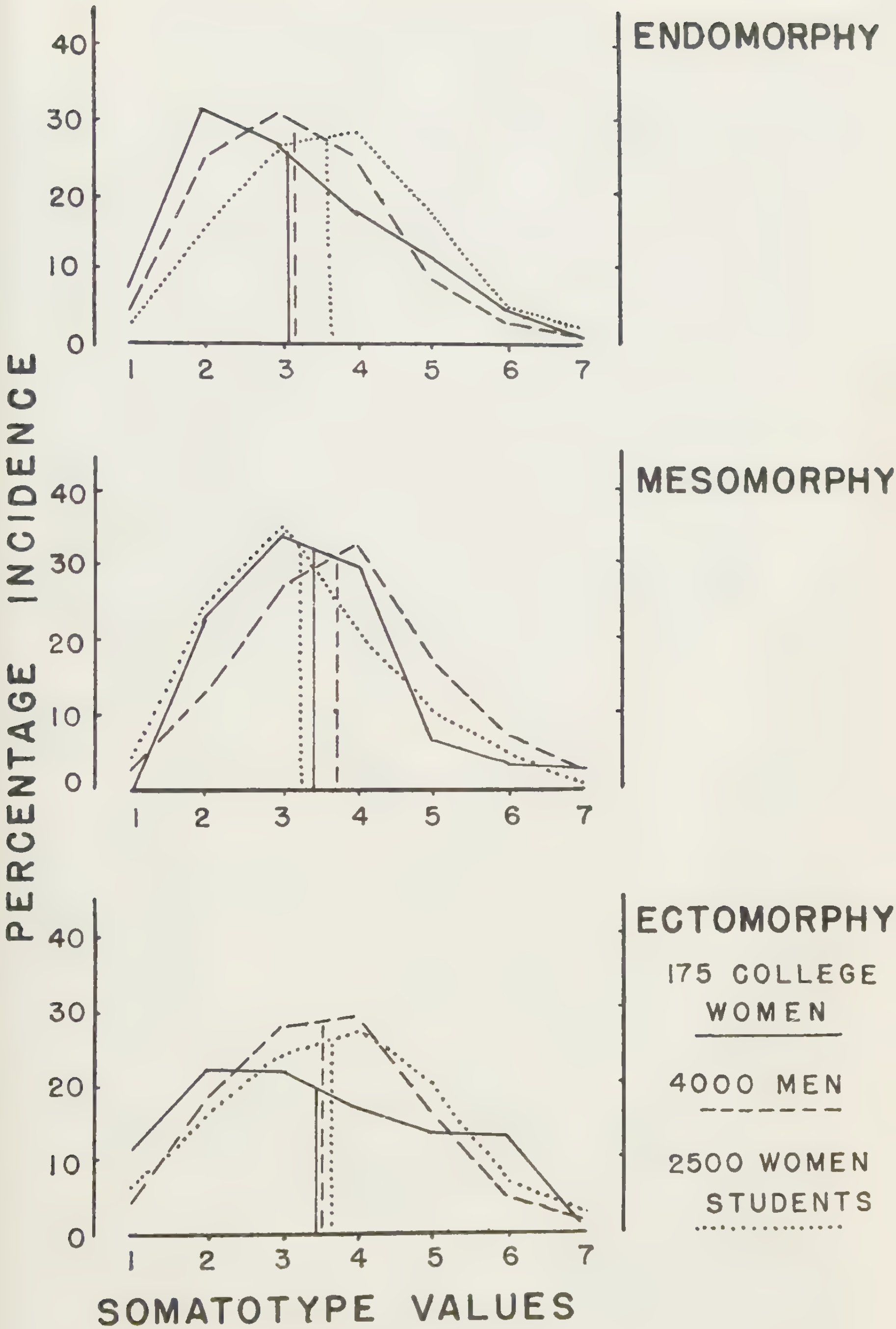

PERCENTAGE INCIDENCE
ENDOMORPHY
40
30
20
10
0
1
2
3
4
5
6
7
MESOMORPHY
40
30
20
10
0
1
2
3
4
5
6
7
ECTOMORPHY
175 COLLEGE WOMEN
4000 MEN
2500 WOMEN STUDENTS
40
30
20
10
0
1
2
3
4
5
6
7
SOMATOTYPE VALUES

Figure 3

The 146 (a raised 1 3½ 6) and three 272's (a raised 1½ 7 1½ and a 1½ 6½ 2) combinations fall over 9 and under 12 so it seems that these may be considered logical results on the whole scale by the present method. The 531 also totals 9 and seems to be a legitimate possibility. It is merely an intermediate neighbor of one of Sheldon's specified groups — 731, 631, 541 and 532 — where, with a little forcing, it might be made to fall and where Sheldonians would assign it.

It is not surprising that 6 of the 10 intermediate somatotypes emerging from the present scoring method are comprised of combinations of 2, 3, and 4 — 234, 243, 324, 342, 423 and 432's. It is obvious that in making judgments of these "average" types, it is very difficult in certain cases, particularly where there is high dysplasia, to decide on the precedence. Sheldon makes his middle group somatotypes with 3's instead of 2's. It is also quite natural when specific items for the dominant components are checked, as by the present system, that there are many of these features lacking in the average "moderate mixture" individual. Since the combinations above — as well as 333 — all total 9, we feel they are valid results from the present method.

Where the selection is guided by the index of linearity as in Sheldon's table ('40, p. 267), this will automatically place these cases in the somatotypes already chosen to fall on a particular index of linearity. Actually, it will be noted in Sheldon's table ('40, pp. 268–269) that there is a range for the occurrence of the index of linearity and the definiteness of placing somatotypes from the index alone has only limited application. Sheldon remarks:

> . . . When we standardize the technique for somatotyping at later age levels, we shall probably attach less weight to this criterion (height over the cube root of the weight) . . . ('40, p. 266).

While the index of linearity gives a rough estimate of amount of padding on the skeleton, it cannot discriminate between the weight of fat and muscle. Therefore, we have preferred to make our observations of the actual situation and

let the index of linearity correlate or not as it happened. Over a large enough sample, certain tendencies would, of course, become apparent. However, due to the "range" of the index relative to somatotypes and the inevitable occurrence of borderline cases, it would seem difficult to provide a reliable substitute for analyzing the facts as they actually appear in a given case.

The problem of dysplasia has been particularly acute in somatotyping women. Sheldon notes this possibility:

> It is fairly clear that there is greater dysplasia in the female body than in the male, or at least that there are greater extremes of dysplasia. It is not uncommon to find female bodies with highly ectomorphic upper segments (arms, upper trunk, head, and neck). But we cannot measure female dysplasia with scientific validity until we first can somatotype an extensive series of the "normal" population in order to establish norms. This we have not yet been able to do.

While Sheldon's range of total dysplasia for men is from 0 to 36, for women we find a range from 14 to 76. Due to the small size of the present series, no gradation into 7 increments of dysplasia was attempted at this time. As well as the fact that we have been dealing with a series of women, it must be carefully noted that the present method of checking specific observable points would tend to lead to greater differences in the different regions of the body than when a judgment of the whole is made and then the regions ranked with this in mind. In checking criteria, we have no predetermined result in mind and accept the observed facts rather than fitting in judgments to make a neat and harmonious picture.

Incidence of 105 criteria — specific observable points. In table 3 we have listed each criterion with the number and percentage of incidence for the 175 women. The same table also gives the incidences of these criteria for the ten best endomorphs (632 to 521), the ten best mesomorphs (272, 163 to 261), the ten best ectomorphs (127, 126 and 226), and ten middle range somatotypes. The latter were selected at random ex-

TABLE 3
Incidence of criteria.

REGION I — HEAD, FACE, AND NECK	NO./175 WOMEN	%/175 WOMEN	10 BEST ENDO	10 BEST MESO	10 BEST ECTO	10 MIDDLE TYPES
Endo						
1. Head large, spherical	37	21	8	0	0	3
2. Face fat (fat cheeks)	66	38	9	1	1	6
3. Face wide: lower width ≅ upper width	13	7	5	0	0	1
4. Soft, round features	38	22	6	0	0	4
5. Clavicular outline softened	74	42	8	4	2	4
6. Short neck	16	9	7	0	0	0
7. Large A–P ≅ Transverse diameter neck	25	14	6	0	0	1
Meso						
1. Head rugged, cubical	97	55	5	9	2	8
2. Face muscled, strong	75	43	0	3	1	6
3. Bones heavy, prominent	55	31	1	9	0	3
4. Heavy features	58	33	2	7	1	1
5. Clavicles heavy, prominent	113	65	4	9	7	6
6. Pyramiding of trapezius muscles	146	83	7	9	8	9
7. A–P < Transverse diameter neck	82	47	3	9	6	3
Ecto						
1. Head small, slight	62	35	0	0	7	3
2. Face thin, puny	24	14	0	2	7	0
3. Bones delicate	64	37	0	0	9	2
4. Small, finely chiseled features	67	38	1	3	10	2
5. Marked clavicular hollow	107	61	1	8	9	6
6. Long, slender neck	47	27	1	1	8	3
7. Small A–P ≅ Transverse diameter neck	49	28	0	1	4	4
REGION II — THORACIC TRUNK						
Endo						
1. Fat, soft roundness	61	35	10	0	0	4
2. Soft back	58	33	10	0	0	5
3. Chest base wide	31	18	6	0	0	2
4. Predominance of abdomen over thorax	0	0	0	0	0	0
5. Wide flare of rib angles	8	5	4	0	0	1
6. High position of lower ribs	42	24	9	0	0	2
7. Fatty pectoral area	130	74	10	5	4	9
Meso						
1. Square, bone-muscle hardness	65	37	0	9	0	3
2. Rugged muscling	27	15	0	9	0	1
3. Broad, athletic taper	47	27	2	8	0	4
4. Predominance of thorax over abdomen	86	49	7	9	0	5
5. Intermediate flare of rib angles	100	57	6	10	1	5
6. Ribs, strong, heavy	51	29	0	10	0	5
7. Muscular pectoral area	63	36	3	8	2	5
Ecto						
1. Linearity, fragility	77	44	0	0	10	2
2. Slight, "thready" muscles	44	25	0	0	10	0
3. Scapulae wing out	87	50	0	4	7	4
4. Thorax narrow and longer than abdomen	75	43	0	0	10	4
5. Acute rib angles	67	38	0	0	9	4
6. Ribs delicate, prominent	51	29	0	0	8	3
7. Flat, bony pectoral area	62	35	0	2	10	1

TABLE 3 — *(continued)*
Incidence of criteria.

REGION III — ARMS, SHOULDERS, HANDS	NO./175 WOMEN	%/175 WOMEN	10 BEST ENDO	10 BEST MESO	10 BEST ECTO	10 MIDDLE TYPES
Endo						
1. Shoulders high, square, and soft	72	41	10	0	0	6
2. Proximal arm segments heavy and greater than distal	30	17	3	0	0	1
3. Rounding and ''hamming'' of upper arm	107	61	9	2	2	9
4. Smooth, plump contours	42	24	7	0	0	1
5. No bony projections	26	15	7	0	0	1
6. Wrists, soft	16	9	3	0	0	0
7. Small, soft hands	36	21	7	0	0	6
Meso						
1. Shoulders rugged, broad	69	39	3	10	0	4
2. Arm segments solid and evenly proportioned	32	18	0	9	0	5
3. Deltoid prominent	52	29	2	7	0	4
4. Heavy muscular relief, forearm diam. ≅ upper arm diam.	38	22	0	8	0	1
5. Bones large, knuckles and joints prominent	31	18	0	9	0	3
6. Wrists massive, bony	15	9	1	8	0	0
7. Large, rugged hands and fingers	14	8	0	6	0	0
Ecto						
1. Shoulders delicate and/or narrow	68	39	0	1	9	2
2. Arms relatively long	66	38	0	0	8	3
3. Weak upper arms	32	18	0	0	8	0
4. Arms spindly	24	14	0	0	8	1
5. Knuckles and joints small	118	68	4	1	10	8
6. Wrists delicate, fragile	107	61	0	0	10	7
7. Fingers fragile, long	135	77	7	5	9	6
REGION IV — ABDOMINAL TRUNK						
Endo						
1. Abdomen large, A–P ≅ Transverse diameter	0	0	0	0	0	0
2. Waist high, faint, wide	34	19	6	0	0	0
3. Abdominal protuberance	116	66	9	3	1	9
4. Fat pads on postero-lateral aspect of upper pelvis	168	96	10	9	9	10
5. Prominent fat on upper thigh	149	85	10	5	4	10
6. Buttocks, soft, round, large	65	37	8	1	0	2
7. Abdominal folds	10	6	5	0	0	0
Meso						
1. Abdomen compact. No diffusion of mass	14	8	0	9	0	0
2. Waist low, medium width	50	29	1	7	1	4
3. Prominent abdominal musculature, no protuberance	19	11	1	8	0	1
4. Sturdy pelvis	91	52	5	10	0	9
5. Firm, muscled upper thigh	18	10	0	9	0	0
6. Buttocks solid, muscular	117	67	3	10	3	8
7. Distinct inguinal line present	27	15	1	5	0	2
Ecto						
1. Abdomen short, relatively inconspicuous	10	6	0	0	4	0
2. Waist slender, often pinched	95	54	0	3	9	6
3. Flat, shallow abdomen	35	20	0	0	8	2
4. Narrow pelvis	40	23	0	1	8	0
5. Thin, stringy upper thigh	25	14	0	1	8	0
6. Buttocks thin, relatively flat	31	18	1	0	7	1
7. Anterior superior iliac spine visible	71	41	2	3	9	3

TABLE 3 — (*continued*)

Incidence of criteria.

REGION V — LEGS AND FEET	NO./175 WOMEN	%/175 WOMEN	10 BEST ENDO	10 BEST MESO	10 BEST ECTO	10 MIDDLE TYPES
Endo						
1. Large A–P ≅ Transverse diameter calves	89	51	10	4	0	6
2. Prox. leg segments heavy and greater than distal	26	15	6	0	0	0
3. Rounding and "hamming" of thighs	88	50	10	2	0	9
4. Thighs approximate (when heels together)	136	77	10	7	1	9
5. Pronounced development of outer calf curve	21	12	4	0	0	1
6. Ankles fat	18	10	4	0	0	1
7. Small, plump feet	18	10	4	0	0	3
Meso						
1. A–P < Transverse diameter calves	2	1	0	1	0	0
2. Leg segments solid and evenly proportioned	92	53	1	10	0	7
3. Heavily muscled thighs	22	13	0	9	0	0
4. Lateral muscling prominent	129	74	3	10	8	9
5. Pronounced development of inner gastrocnemius	123	70	6	9	10	7
6. Ankles thick, bony	89	51	5	9	4	3
7. Thick, heavy feet	12	7	0	4	0	0
Ecto						
1. Small A–P ≅ Transverse diameter calves	72	42	0	1	9	4
2. Legs relatively long	69	39	1	0	8	3
3. Weak thighs	37	21	0	0	10	0
4. Space between thighs (when heels together)	35	20	0	2	8	0
5. Legs spindly	4	2	0	0	1	1
6. Ankles delicate fragile	61	35	2	0	5	3
7. Toes fragile and (tend to be) long	127	73	5	6	10	3

cept for the stipulation that no variable should be more than 4 nor the dysplasia over 42.

From inspection it will be noted that for all variables for all regions the ten middle types occupy a mean position relative to the endos, mesos, and ectos, and that they reflect the incidences for the whole series. It will also be noticed that for any given variable in any given region, for example the endo criteria for the thoracic trunk, the endo criteria which show up in the mesos and ectos are relatively common in that area for the whole series.

This part of the table is useful as suggesting criteria which may be considered feminine because found in all "best" somatotypes or distinguishing other items which clearly correlate with fat, muscle, or thinness.

DISCUSSION

It is of interest to examine the percentages of incidence of the specific criteria to see which features distinguish this group of normal college women. The percentages which fall at 70% or above include:

Fat on postero-lateral aspect of upper pelvis — 96%
Prominent fat on upper thigh — 85%
Thighs approximate — 77%
Fatty pectoral area — 74%
Fingers fragile, long — 77%
Toes fragile and (tend to be) long — 73%
Pyramiding of trapezius muscles on either side of neck — 83%
Prominent lateral muscling of thighs — 74%
Pronounced development of inner gastrocnemius — 70% (Calf shadow and curving silhouette)

Although there may easily be discrepancies in individual borderline judgments, the large incidences of the above criteria tend to suggest that these are significant criteria for normal college women. The fat on the sides of the pelvis is very easy to locate and identify in a photograph; therefore this finding is relatively dependable even in this introductory study. It seems safe to assert, what common observation has noted, that women tend to accumulate fat pads over the upper sides of the pelvis. The prominent fat on the upper thigh is similarly clear. The lateral projection from the buttocks makes a curving silhouette by which the presence of this fat placement is clearly located. This is not as common as the upper accumulation of fat. In the highly muscular or very thin girl, it is less common. In the samples of the ten best ectos and mesos, it occurs about half the time. However, the fact that these two mounds of fat occur in 85% of the college women and produce a double curve to the silhouette shed considerable doubt as to the reliability of "the even feminine sweep from waist to knee" — the "feminine ellipse." This appears to be a cultural illusion perpetuated by clever girdle manufacturers. When the "feminine ellipse" is used to label a man "weak

masculine" or "feminine," is would seem to bear careful scrutiny in the light of the present findings as to the normal woman.

The thighs approximate in 77% of the cases but this is not an evenly distributed item in occurrence. Of the best ecto group, only 1 has thighs approximate whereas 8 show space between the thighs. Twenty per cent of the college women have space between the thighs. This per cent may be even higher in actual incidence as where there was any doubt in judging the photographs due to placing of heels, approximation has been checked as present. If at least 20% of the normal college women do not have thighs approximate, and if many of these same women are decidedly thin or thin and muscular, it throws doubt on the use of the approximation or thigh space as a sex criteria and places the emphasis on the amount of fat or thinness in a given individual. Although the feminine tendency to have fat in two places in the thigh-pelvic area favors the presence of sufficient flesh to make the thighs meet, it cannot be considered unfeminine for thin women to lack this feature. By the same token, the fat man cannot be expected to display "space between the legs" when accumulation of flesh makes this result impossible.

It is of interest to note the closeness of percentages of incidence of long, fragile toes and fingers. The fingers and hands have been very easy to note in this series. There have been difficulties in rating the feet as, unfortunately, 24% of the girls wore socks or shoes when the pictures were taken. For this reason, only long feet of narrow overall silhouette have been marked ecto. In many instances thin, long toes could be observed in outline even through the stockings or open sandals. Therefore, while this item is not totally reliable in the present series, the correspondence with the long, fragile fingers would give it some measure of worth and the absence of many markedly massive hands and feet suggests that we may note the tendency to dainty hands and feet in a series of normal, young college women. The occurrence of very short, fat feet is rare. Of course, there are few very fat girls in the

series. It is generally observed that women tend to have daintier hands and feet than men, and a male series would be expected to show a higher incidence of massive feet. It should be mentioned that this observation is much more satisfactory when made on the living as the foreshortening in a photograph and the comparative smallness of toe sizes make comparisons difficult. Therefore later findings may minimize the present trend.

Extreme variation in pubic hair was found including all the recognized patterns. While there was a strong tendency for fan shaped, often small, designs to go with endomorphy; an equilateral triangle, often bushy, to go with mesomorphy; and a narrow isosceles triangle to go with ectomorphy, there were many exceptions or combined patterns. In two cases, there is a line of hair running up to the navel. One was a 2 5 3½ somatotype: the other a 4 3 3. While mesomorphy is predominant in the first instance and present in the second, these are not examples of extreme mesomorphy. Also, the lack of this situation in the other similar somatotypes raises difficulties of interpretation.

The present series is not large enough to establish the validity of the tendencies noted in pubic hair pattern. However, it is convincing proof that in a series of normal young women (in which no cases of amenorrhea are present), there is no such thing as a universal "feminine arrangement of pubic hair."

The incidence of abdominal protuberance is of interest. It was observed in 66% of the college women. This is a high incidence. However, 20% had ectomorphic abdomens and 11% mesomorphic. The pattern of distribution among the somatotype groups is similar to the approximation of the thighs. Only one ecto in the best ecto group displays either trait. However, practically all of the best endos display both traits. This point does not need to be labored further. Although abdominal protuberances are common in women and lack of good muscle tone and child-bearing (in later age groups) increase the number with this feature, yet we must remember

that approximately one-third of the college women were thin or muscular as opposed to the two-thirds who showed the abdominal protuberance. It would appear that the occurrence of the abdominal protuberance is a question of high percentage incidence in normal women rather than absolute universality. It will be noticed that it was very low in the ten best mesos and ectos.

The three items which show muscle development in normal young women are worth considerable note due to many prevalent theories to the effect that the male has a prerogative on muscle development. Though the male may have greater size of muscle development in many cases and show higher total incidence of mesomorphy, as in Sheldon's 4,000 college men as compared with the college women, yet there is distinct presence of muscle development in many women. The three muscle observations discussed here are particularly easy to make. The trapezius makes a curving line from shoulder to neck in silhouette which is easy to locate. The lateral muscling of the thighs is checked as present only when there are vertical lines evident in the photograph which outline the large muscle groups as they appear above the knee. (The upper thigh muscles are difficult to see in a photograph and often are overlaid with the thigh and pelvic accumulations of fat. They have received only a 10% total incidence, although 9 of the best 10 mesos have this feature.)

The inner gastrocnemius development has been checked only when it has shown a definite shadow in the photograph and a curving silhouette. In practically every instance, the inner calf curve has been greater than the outer, but where the outer is present and pronounced also, both items have been checked. Therefore no outer calf development which could be called "pronounced" has been intentionally omitted. However, there is only an incidence of 12% for "Pronounced development of outer calf curve." From the "10 bests" it appears to correlate with endo (fat). As the inner gastrocnemius development has been called "the male calf" and the outer calf curve "the female calf," it is of interest to have a series of

normal young women to check for this item. As it appears in ectomorphs and endomorphs as well as mesomorphs (see big incidence in "10 best," table 3), it would tend to suggest that this muscular development — as it cannot be an outstanding "sex" criteria for both sexes — may be tied in with function. The development of the gastrocnemius is a striking feature of the series of college women.

The present findings suggest the interpretive value of specific observations combined with the ascertaining of the basic over-all somatotype. As more data accumulate, the delineation of the relative importance of certain criteria for men and women or for given groups of individuals will be based on a solid foundation of factual evidence.

Eventually, it is hoped, baselines of somatotype distributions and incidence of particular criteria will be available for comparative purposes both for the sexes and for different age groups. By comparable or sequential series of this kind, many issues which are now highly controversial will become clarified in the light of concrete observational findings.

SUMMARY AND CONCLUSIONS

1. In using the somatotype body build description, an introduction is made to the study of the individual. To produce recommendations for the solution of problems of fatigue in college women, further studies are indicated.
2. A tabulation method of somatotyping has been developed with the use of specific observable points instead of a "rating scale" technique. The points have been taken directly from Sheldon.
3. One hundred and seventy-five body build photographs of normal college women have been analyzed.
4. The findings in incidence of somatotypes are compared with Sheldon's series of 4,000 college men, 1,000 Harvard men (Dupertuis, unpublished), and 2,500 estimated somatotypes of women from bromide silhouettes.
5. The distribution of the variables and spread of dysplasia is noted.

6. The percentage incidence of the specific criteria is listed and discussed briefly. It appears that series of men and women should be checked to ascertain the individual body build distribution for women and to compare the incidence of the specific criteria for large male and female series.

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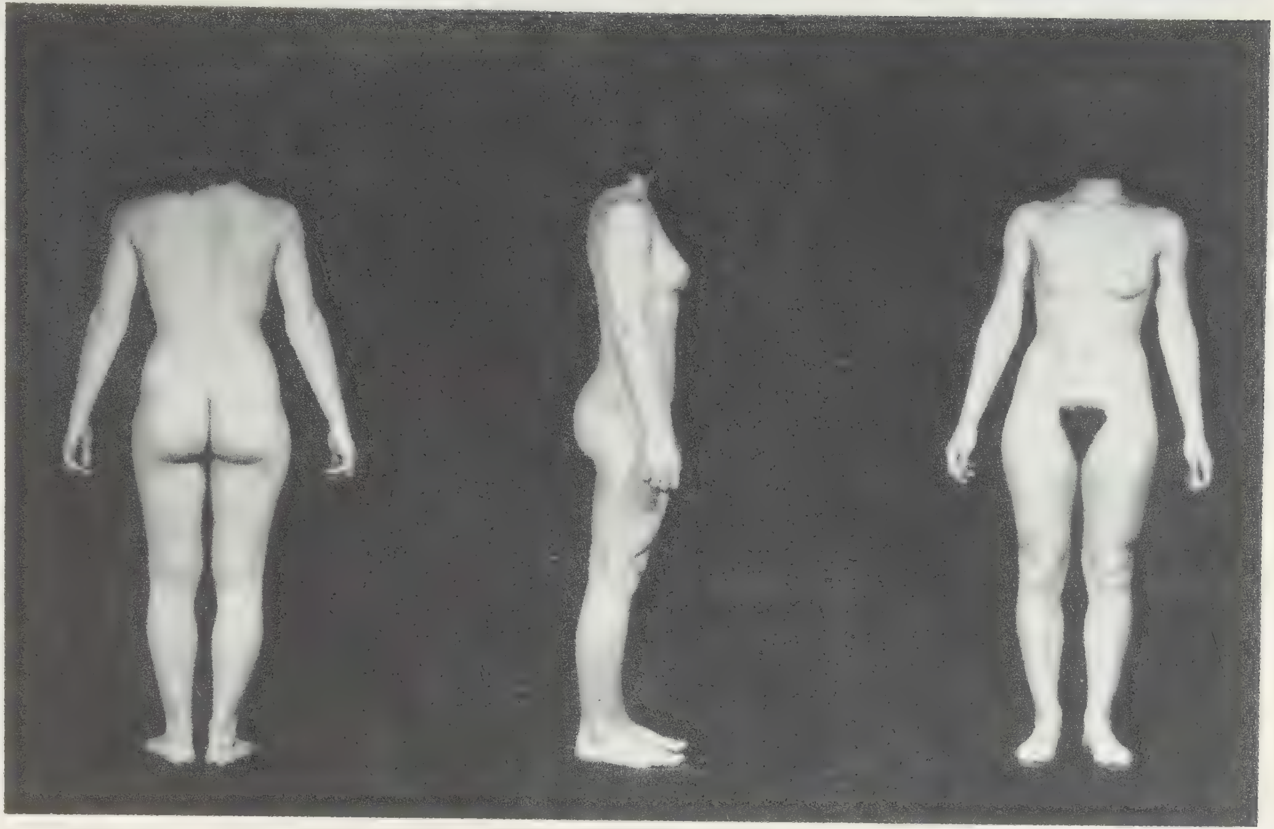

Somatotype 2 6½ 1

PLATE 3

Somatotype 1 2 7

SKELETAL CHANGE IN ANCIENT GREECE

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INTRODUCTION

Cyclic changes in body structure give the human biologist some of his most intriguing problems. In spite of difficult material the present example is no exception to this statement. The Greeks also interest us peculiarly since they transformed Near Eastern into European civilization. And a description of their average body build, posture, and skeletal structure will be the first scientific record of the physique of any of the creators of Western culture except for that of the ancient Egyptians.

I have examined the skeletal remains [1] of about eighty males and fifty females, represented by at least one bone, from all periods from Neolithic through Byzantine.[2] Preservation is even worse than that of the 455 ancient Greek skulls available (Angel, '44): only fifteen skeletons are fully measurable. This results from marked seasonal fluctuation in Greek soil conditions as in all temperate regions, from communal burial customs of Early and Late Bronze Ages, and somewhat from archaeological selection. It is almost unusual

[1] Gathered chiefly in 1938 under the auspices of Harvard University and the American School of Classical Studies at Athens. I should like to thank Dr. Hooton, Dr. Chase, and Dr. Jackson of Harvard University for giving me the opportunity to make this study. Space does not allow me to thank everyone who has helped me, but I am particularly grateful to the many Classical Archaeologists whose interest in preserving the normally much broken remnants of ancient Greek skeletons gave me my material.

[2] Measurements from Fürst ('30) are included for twenty-four individuals whom I was unable to remeasure, mainly of Middle Bronze Age date.

for both bones of any bilateral pair to be preserved for measurement. Paired bones have been averaged, therefore, and bodily asymmetries ignored in presenting type and chronological subgroups in tables 3 and 4. Environmental stringencies which reduce measureability also select. Hence it is natural to find more males than females, more femora than humeri, and more innominates than scapulae in measureable condition. Robust or young individuals survive more often than weak and old ones. But such selection brings no more confusion than the effects of social selection in both ancient and modern series.

DESCRIPTION

Mean measurements, proportions, and morphology of the ancient Greek male and female are listed in tables 1 and 2 to provide background for chronological changes and for outside comparisons. Comparison with column 2 in table 4 shows that the total series most nearly represents the average Greek of the Early Iron Age (Submycenaean, Protogeometric, and Geometric periods) rather than Classical times. In comparing the average ancient Greek with the outside groups in table 4, columns 4 and 5, peculiarities of the latter are important. Medieval Irish monks, from extensive publication of Howells ('41), represent a heavy-bodied and robust population mainly of Upper Paleolithic, Iron Age Nordic, and Atlanto-Mediterranean derivation. Hrdlička ('32) found immigrant Irish long bones the most robust and flattened of his subgroups. The modern American composite shows discrepancies from inevitable use of different sets of data, including x-ray derived measurements on English as well as American pelves (Young and Ince, '40).

Age at death can be approximated closely by estimate of the phase of the pubic symphyseal face according to Todd's ('20, '21) criteria. Greek mean age at death in table 2 is younger than that estimated from the skulls and much younger than that of Irish monks. Relative youth of the females is striking though it must result partly from more sluggish

T A B L E 1

Mean measurements and indices of skeletons of the total series of males and of females of all periods from Neolithic to Byzantine in mainland Greece

	M A L E S					F E M A L E S			
	Right		Left		Range both sides	Right		Left	
Diameter	Mean	N	Mean	N		Mean	N	Mean	N
HUMERUS									
Maximum length	310.43	23	308.85	26	266-350	294.92	12	296.43	21
Maximum head diameter	46.00	21	45.39	18	38- 51	41.69	8	41.50	16
Maximum mid-shaft "	22.24	38	21.79	34	15- 26	20.22	23	19.87	24
Minimum mid-shaft "	17.42	38	17.09	34	13- 21	15.22	23	15.29	24
RADIUS									
Maximum length	238.12	24	235.05	19	214-269	220.00	16	220.61	18
ULNA									
Maximum length	259.25	24	259.06	16	229-291	240.21	14	237.71	14
CLAVICLE									
Maximum length	141.94	18	146.56	16	122-162	137.29	7	136.85	13
SCAPULA									
Total height	153.25	11	(both sides)		130-177	136.50	8	(both sides)	
Inferior height	115.75	12	(" ")		94-137	100.31	8	(" ")	
Breadth	104.27	13	(" ")		94-110	94.50	8	(" ")	
FEMUR									
Bicondylar length	425.74	34	430.62	32	365-497	408.00	23	418.72	18
Maximum length	430.91	37	434.26	34	370-500	410.37	27	421.30	20
Maximum head diameter	46.41	37	46.06	32	40- 53	41.77	26	41.62	21
Subtrochanteric A - P	25.96	46	26.50	36	20- 31	24.11	28	23.54	28
" lateral diam.	32.74	46	32.94	36	27- 39	29.62	29	30.25	28
Mid-shaft ant.-post.	28.68	47	29.17	36	21- 36	26.33	30	25.58	31
Mid-shaft lateral	27.40	47	27.78	36	24- 32	24.57	30	24.77	31
TIBIA									
Diagonal length	351.67	30	349.48	29	296-395	340.06	16	342.31	16
Nutrient foramen A-P	34.76	37	34.74	39	28- 42	30.48	25	30.83	23
" " lateral	23.57	37	23.56	39	20- 28	21.68	25	21.35	23
FIBULA									
Maximum length	345.07	14	345.14	14	315-386	329.50	6	331.80	5
CALCANEUS									
Maximum length	79.57	23	80.42	19	71- 89	76.50	10	74.77	13
Maximum breadth	43.44	25	42.37	19	37- 48	39.09	11	38.83	12
TALUS									
Sulcus-head length	53.00	23	52.63	19	47- 61	48.18	11	48.27	15
Transverse breadth	43.57	23	43.21	19	38- 50	38.67	12	38.36	14
Projective height	30.96	23	31.00	19	27- 36	28.82	11	28.47	15
PELVIS									
Innominate height	209.65	24	(both sides)		180-240	199.41	17	(both sides)	
Innominate breadth	156.79	21	(" ")		137-178	155.33	17	(" ")	
Bi-iliac breadth	272.07	14			237-291	269.63	11		
Least bi-ischial br.	145.93	14	5-segmt.sacra		127-167	160.67	12	5-segmt.sacra	
Inlet breadth	125.47	17	127.60	10	111-138	134.77	13	131.78	9
Inlet antero-post.	103.47	15	101.50	8	90-121	112.36	11	103.29	7
Sacral height	109.67	18	105.45	11	93-143	110.23	13	103.14	7
Sacral breadth	107.33	24	108.71	14	95-115	109.30	10	107.29	7
LUMBAR VERTEBRAE									
Anterior heights	136.26	19			128-150	133.62	13		
Posterior heights	133.53	19			120-153	129.69	13		
STATURE in cm.	162.19	61	(individual reconstructions)		148-175	153.35	43	(individual reconstructions)	
Index									
BODY BUILD									
Humero-radial	75.63	16	76.15	16	70- 80	75.17	9	74.42	12
Humero-clavicular	45.73	10	48.28	14	42- 53	46.52	5	47.11	9
Femoro-humeral	72.65	17	71.35	18	68- 75	71.27	7	70.43	12
Femoro-tibial	81.87	24	82.23	22	80- 87	81.96	14	81.59	12
Relative hip breadth	16.71	13			15.0-17.6	17.42	11		
Femoral "robusticity"	12.93	29	13.02	25	11.6-14.5	12.45	18	12.19	14
INTRAMEMBRAL									
Humeral flatness	78.39	38	78.53	34	66- 91	75.32	23	77.64	24
Platymeric (femur)	79.12	49	79.84	38	64- 94	81.56	29	79.17	28
Pilastric (femur)	105.21	49	104.97	37	86-130	107.44	30	103.30	30
Cnemic (tibia)	68.36	39	68.20	40	61- 81	71.39	26	69.35	23
Calcaneus length-br.	53.14	22	52.68	17	50- 57	51.79	9	52.25	12
Talus length-height	58.41	23	58.92	19	53- 65	59.60	10	59.48	14
Innominate height-br.	74.93	20	(both sides)		61- 91	78.14	15	(both sides)	
Total pelvic br.-ht.	78.12	13	5-segmt.sacra		72- 86	73.53	11	5-segmt.sacra	
Pelvic inlet br.-depth	82.27	14	79.21	8	72- 99	83.25	11	79.14	7
Sacral height-breadth	99.73	16	104.48	10	67-120	101.87	9	103.14	6
Vertical lumbar	98.05	19			91-111	96.29	12		

Note : Stature derives from formulae of Pearson in Martin, '28, pp. 1070-1071, based on central French not unlike Greeks. Measurements follow Martin's definitions.

TABLE 2

Morphological observation percentages on ancient Greek skeletons of both sexes

Observation	MALES Right	MALES Left	FEMALES Right	FEMALES Left
HUMERUS				
Shaft section	39	36	22	26
Oblong	5.1	0	0	3.8
Plano-convex	17.9	22.2	27.3	23.1
Prismatic	23.1	41.7	50.0	53.9
Irregular	33.3	22.2	13.6	15.4
Trapezoid	18.0	13.9	9.1	3.8
Oval	2.6	0	0	0
RADIUS				
Degree bowing	32	33	22	23
Slight	50.0	42.4	31.8	34.8
Medium	50.0	54.6	68.2	65.2
Pronounced	0	3.0	0	0
SCAPULA				
Vertebral border	12	13	5	6
Convex	66.7	53.8	60.0	50.0
Straight	16.7	23.1	0	16.7
Concave	16.6	23.1	40.0	33.3
Acromion form	21	20	12	10
Sickle	4.7	5.0	8.3	20.0
Triangular	14.3	30.0	33.3	20.0
Intermediate	28.6	10.0	16.7	0
Quadrangular	52.4	55.0	41.7	60.0
FEMUR				
Crista hypotroch.	44	35	29	26
None or small	25.0	28.6	58.6	50.0
Medium	43.2	45.7	20.7	23.1
Large	31.8	25.7	20.7	26.9
Fossa hypotroch.	44	35	28	27
Shallow or none	65.9	60.0	64.3	66.7
Medium	22.7	34.3	25.0	25.9
Deep	11.4	5.7	10.7	7.4
Third trochanter	40	34	28	26
None	60.0	55.9	42.9	42.3
Small	25.0	35.3	42.8	34.6
Medium	12.5	5.9	10.7	19.2
Large	2.5	2.9	3.6	3.9
Degree torsion neck	36	30	22	17
Negative & none	11.1	13.3	9.6	23.5
Slight	44.5	40.0	54.6	53.0
Medium	36.1	43.4	31.8	23.5
Pronounced	8.3	3.3	0	0
Degree bowing	45	38	31	27
None or slight	22.2	34.2	38.7	44.4
Medium	73.3	60.5	51.6	51.9
Pronounced	4.5	5.3	9.7	3.7
Gastrocnemius facet	31	28	22	21
Absent	51.6	50.0	36.4	47.6
Present	48.4	50.0	63.6	52.4
TIBIA				
Retroversion head	27	28	17	15
None	7.4	7.1	5.9	0
Slight	25.9	14.3	29.4	13.3
Medium	63.0	75.0	52.9	73.3
Pronounced	3.7	3.6	11.8	13.4
Shaft section	38	40	26	23
I : Prismatic	13.2	5.0	23.1	13.0
II:Lateral prism	31.6	42.5	7.7	30.4
III: " concavity	18.4	15.0	15.4	21.8
IV : Diamond	28.9	35.0	50.0	34.8
V:Rounded prism	7.9	2.5	3.8	0
Squatting facets	28	26	15	16
Present	67.9	69.2	46.7	68.7
Absent	32.1	30.8	53.3	31.3

Observation	MALES Right	MALES Left	FEMALES Right	FEMALES Left
CALCANEUS				
Axis tuberosity	24	19	10	13
Pronounced tilt	4.2	5.2	0	0
Medium tilt	58.3	47.4	40.0	42.9
Vertical	37.5	47.4	60.0	57.1
Achilles tendon	24	19	11	14
Placed low	12.5	10.5	9.1	14.3
Medium	62.5	79.0	72.7	64.3
High	25.0	10.5	18.2	21.4
TALUS				
Diversion neck	24	19	12	16
Pronounced	16.7	10.5	8.3	0
Medium	50.0	47.4	50.0	75.0
Slight	33.3	42.1	41.7	25.0
Torsion axis head	23	19	11	15
(tilt Marked	30.4	26.3	36.4	46.6
from Medium	56.5	47.4	54.5	46.7
vertical) Slight	13.1	26.3	9.1	6.7
Squatting facets	23	18	12	15
Present	65.2	66.7	16.7	26.7
PELVIS				
Ischiatic notch	28	27	27	26
Narrow	67.9	70.4	3.7	3.9
Medium	32.1	25.9	29.6	34.6
Wide	0	3.7	66.7	61.5
Preauricular sulcus	28	28	25	25
Absent	75.0	71.4	12.0	12.0
Small	14.3	21.4	8.0	4.0
Medium	10.7	7.2	36.0	28.0
Large	0	0	44.0	56.0
Laterally flaring	26	25	21	21
iliac crests	26.9	36.0	23.8	28.6
Sub-pubic angle		25		18
Narrow	72.0		0	
Medium	24.0		27.8	
Wide	4.0		72.2	
Pelvic inlet shape		22		17
Heart & prism	68.2		0	
Narrow oval	18.2		11.8	
Broad oval	13.6		88.2	
Sacrum segment no.		27		17
Five segments	59.3	Mean no.	70.6	Mean no.
Six (lumbar)	29.6	segments	5.9	segments
Six (coccygeal)	11.1	5.4	23.5	5.3
Spinal closure starts		19		14
at mean segment	3.7		3.8	
Sacral curve starts		25		16
at mean segment	3.5		3.3	
Degree sacral curve		26		16
Slight	42.3		25.0	
Medium	34.6		56.2	
Pronounced	23.1		18.8	
Sacral type		28		30
Hypobasal	39.3		40.0	
Homobasal	32.1		15.0	
Hyperbasal	28.6		45.0	
Pubic symphysis phase		22		16
I (18-19)	0		18.8	
II (20-21)	4.5	Mean	12.5	Mean
III (22-24)	4.5	age	12.5	age
IV (25-26)	4.6	at	0	at
V (27-30)	18.2		31.2	
VI (31-34)	13.7	death	12.5	death
VII (35-39)	22.7	35.5	12.5	27.0
VIII (40-44)	22.7		0	
IX (45-49)	9.1		0	

Note : Age phases of the pubic symphysis follow the descriptions of T.W. Todd,'20,'21.

phase change usual in females. A disproportionate number of young pelves undoubtedly survived in both sexes, but even so death before forty is the inescapable average.

Aside from small size and slight shaft flatness the humerus is not remarkable. Its shaft cross section is more prismatic than plano-convex, middle diameters are large-medium compared to length, olecranon septum perforation occurs on either side in 15% of forty males and 33.3% of twenty-seven females, and a supracondyloid process occurs once in each sex.

Forearm bones show average bowing with females more bowed than males, and well-develpoed crests for the interosseous membrane. The shoulder-girdle is powerful with short robust clavicles and relatively large scapulae. Origin surfaces for teres muscles on the axillary border are generally pronounced in males, the acromion process tends to be quadrangular giving an extensive deltoid origin, and the vertebral border of the scapula is as often convex as usual among healthy whites (Graves, '24). Out of fifteen sterna six rib facets were noted five times, seven in nine cases, and eight once.

Leg bones are remarkable for platymeria, mesocnemia, relatively thick shafts, and marked muscle attachments: on the well-bowed femur the crista hypotrochanterica is rugose equalling that of Irish monks in the males and less developed in the females who show, on the other hand, an excess of third trochanters over the males. Torsion of the femoral neck relative to the lower epiphysis and shaft is well-developed for Europeans (slightly less than in Irish monks) especially in the males. Tibial cross sections fluctuate between diamond shape (IV) and oblique prismatic (II) according to the Hrdlička classification, showing an extensive surface behind the interosseous membrane (more diamond shape than in Irish monks). Retroversion of tibial head and frequency of squatting facets at the ankle joint exceed Medieval Norwegians (Wagner, '26), Irish monks, and modern whites.

The tarsus shares the small size of the rest of the skeleton. The tuberosity axis of the calcaneus is less tilted (primitive)

than in Irish monks, though the lateral process of the tuberosity is no better developed in the Greeks. Facets on the sustentaculum tali tend to be fused more often than in Irish monks. Though the lateral calcaneal facet of the talus is oblique (primitive) much more often than in Irish monks and the head's axis is less vertical (primitive) the head and neck diverge medially less than in Irish monks (advanced). Extension of the trochlear surface onto the neck of the talus is as frequent as the corresponding tibial squatting facets in the males but rare in Greek females where its frequency equals that in Irish monks.

The Greek pelvis is less reduced than the rest of the skeleton.[3] Relatively high innominates have laterally flaring rather than erect ilia. The true pelvic inlet is broader than in modern whites, but is also more ovoid and less prismatic and anteriorly angled than in Irish monks, with narrower ischiatic notches than the latter though perhaps less funneling.[4] The sacrum is both higher and narrower than the Irish, well curved, with less than usual dominance of the hypo- and homo-basal sacral types and hence an incipient hyperbasal tendency for the wings to rise higher than the upper surface of the centrum of the first sacral vertebra. This "advanced" evolutionary tendency is clearer among the females as expected, whereas males show frequent sacral incorporation of the fifth lumbar vertebra. Six segment sacra are unusually common (cf. Schultz, '30, pp. 322–323). Lumbar vertebrae show no size reduction and the lumbar curve is less marked than expected.

Description of the average ancient Greek skeleton is best focussed in a discussion of body build, posture, and sex differences.

[3] It appears as large as in Irish or other big-bodied modern Europeans. But this is a result of excess of historic period pelves in the total Greek series.

[4] Male interspinous breadth at 89.54 (13), range 70–121 differs less sharply from the female mean of 110.09 (11) than expected according to the least bi-ischiatic breadth contrast (measured between the obturator grooves), showing diminished accuracy of the former measurement.

Body build

Stature is below average for whites if the Pearson formula be trusted. In body proportions the forearm is medium-long relative to the arm (Schultz, '37), though not approaching predynastic Egyptian (Warren, 1897), negroid, or American Indian elongation (Martin, '28, p. 395. Hrdlička, '32). The clavicle is not short compared with the humerus [5] though it is not absolutely long. Scapula size strengthens an impression of strong if not strikingly broad shoulders. Normal white thigh-leg and thigh-arm proportions suggest that the upper extremity shows incipient elongation relative to stature. Large and relatively broad pelvis and relatively thick long bone shafts (though without large joints) complete the picture of a stocky and robust build. Large size of the lumbar vertebrae and suggestions of reduction in the number (cf. Schultz, '30, p. 318, Kühne, '32, pp. 214–221) of pre-sacral vertebrae (four cases confirmed) fit this conclusion. An attempt to somatotype thirty-four males according to those of Sheldon's ('40) criteria which are applicable to skull and skeleton results in a mean somatotype of 3.3 – 3.9 – 3.4.[6] This deviates slightly from the modern American male average of 3.2 – 3.8 – 3.5 (Sheldon, '40, p. 127) in the same direction as the proportions suggest: heavy stockiness and robusticity.

In spite of dearth of paired long bones asymmetries seen in table 1 are normal (cf. Martin, '28, pp. 439–446. Schultz, '37. Howells, '41, pp. 183–185): increased total size of right upper extremity, relative elongation of left clavicle, and increased size of left femur though of right tibia. The Greek females show elongation of left tibia as among Irish monks, suggesting that in normal increased left leg length femoral asymmetry is the determining factor.

[5] Humero-clavicular indices together scarcely exceed the Irish.

[6] Very much greater weight was given to the skull than to the first body region of the living. The following skeletal criteria were used: index of robusticity, development of muscle crests, relative size of feet, relative breadths of pelvis and of shoulders.

Posture

Analysis on the basis of skeletal remains is risky because of the dynamic nature of posture. From a purely static point of view correlation of a lumbar curve very slightly straighter than in modern whites with slightly more than usual femoral torsion is a natural one. Torsion brings the femoral shafts into line with the centre of gravity in cases where the acetabula are slightly in front of it, as among Australian aborigines where flat lumbar curve accompanies feeble pelvic tilt.[7]

Dynamic aspects of posture are more relevant. Since the Greek material is too scanty for the desirable series of associations between peculiarities of femur, tibia, foot, pelvis, and vertebrae I must rely on the average condition and on correlations derived from other series. It is probable that definite degrees of flattening of femur and tibia reflect muscular stress connected with posture.[8] Among Greeks in addition to platymeria and relative platycnemia functional interpretation is clarifying for iliac flare, femoral torsion, strong gluteal crest on the femur, slight femoral pilastering and bowing, frequent medial gastrocnemius facet, retroversion of tibial head, diamond shape cross section of tibial shaft, various details in the tarsus, and so-called squatting facets.

Various observers have found associations between most of these characters. Femoral torsion, strong third trochanter, and tibial retroversion all are associated closely with one another in the Irish (Howells, '41, pp. 167–173), showing a tendency for hypertrophy of the proximal part of the deep portion of the gluteus maximus to accompany habitual use of a bent-knee position in locomotion, with slight shifting backward of the centre of gravity. In medieval Norwegians

[7] Cf. Martin ('28) p. 1080. But no study has examined the accuracy of correlation between the vertical lumbar index and the lumbar curve on the living. Todd and Pyle ('28) regard the latter as too mobile to measure accurately.

[8] But note the general correlation between flattening of shafts of all long bones, emphasized separately by Hrdlička ('32) and Buxton ('38) who hint at racial and environmental causes respectively. The latter seems more important.

Wagner ('26, p. 115) finds similar association of increased femoral torsion with increase in rugosity and area of gluteus maximus (deep portion) insertion on the femur, in addition to associations of torsion with increased platymeria (lateral rotator and abductor stresses?) and of tibial head retroversion with increased platycnemia (Wagner, '26, pp. 116, 129). Manouvrier (1888, 1893, 1893 a) much earlier argued for general association of platymeria, platycnemia, tibial retroversion, channeling of fibula, rugose gluteal crest, and sometimes femoral pilastering as a total response to muscular hypertrophy of the whole lower extremity, assuming, of course, that no shaft length increase gave extra area for muscle attachment. Buxton ('38) shows definite association of platymeria with platycnemia in a Romano-British series, and stresses the importance of any factor affecting the relationship of bone area to muscle attachment needs in the development of shaft flattening. And Charles (1894) clarified the role of hyperdorsiflexion (in squatting) in producing squatting facets and showed probability of their linkage with platycnemia.

Rather greater than usual medial rotation of the Greek talus with reference to the calcaneus together with lack of verticality of the head of the talus suggest a broad and possibly slightly primitive foot. This, all of the characters just outlined, and the well-developed calcanear tuberosity suggest hypertrophy of all leg muscles especially of the following groups: abductors, extensors, and especially external rotators of the thigh, the three vasti extending the leg, and all extensors (plantar-flexors) of the foot.

Such extra development is clearly part of dynamic posture, gait rather than stance, as Manouvrier pointed out in criticising (1893) Fraipont's emphasis on stance as cause of tibial retroversion. Greek countryside is not only steeply mountainous with almost no gently sloping roads, but slippery talus covers most of the slopes traversed on a foot journey. This demands a springy and flexible gait with knees bent like those of a skier especially in descending slopes. The

three indispensable elements in this gait are flexible balance with sidesway at waist and hips, well-bent knees to lower and easily to shift the centre of gravity, and easily flexed, strong feet to adapt to sliding irregularities of surface. This is an efficient rather than slouching posture, is normal among modern Greek shepherds and farmers, and of course is never used on level ground.

The first element, pelvic balance (cf. Reynolds, '31), involves not only strong glutei, tensor fasciae latae, and external rotators (to prevent toeing in as well as sidesway), but also strong lateral abdominal, quadratus lumborum, and iliocostalis muscle groups. The skeleton reflects this emphasis in strong iliac crests and gluteal crests, perhaps in femoral torsion, and certainly in platymeria: excess pull of gluteus medius and minimus, piriformis, obturator internus and gemelli, and obturator externus in controlling sidesway must put more lateral-medial than anteroposterior strain on the upper third of the femoral shaft down from the greater trochanter.

The second element, bent knees, involves emphasis on posterior fibres of gluteus maximus, on the quadriceps femoris, and to a minimal degree on the calf muscles. This is reflected in strong gluteal insertions, in thick femoral shafts with incipient pilastering, in platymeria,[9] and most clearly in retroversion of the tibial head (hypertrophy of the posterior cruciate ligament would be expected, but no observations on this were taken).

Full development of calf muscles linked with the third element in the gait, hyperdorsiflexion of the foot, splits into two parts. Strong triceps surae is indicated by calcaneal surface for the tendon of Achilles, by diamond shape tibial shaft cross section and frequent emphasis on the popliteal line giving origin to part of the soleus, and by frequent occurrence of a facet (Genno, '31) on the postero-medial

[9] Manouvrier (1893 a) stresses importance of the vasti, especially v. lateralis, in platymeria and pilastering. It is not surprising that he finds these negatively correlated since any increase in shaft surface will allow stronger muscle attachment.

surface of the adductor tubercle of the femur connected with the medial head of the gastrocnemius.[10] Linked with tibial and talar squatting facets hyperdorsiflexion demands strong support from tibialis posterior (Charles, 1894) and the long flexors of the toes (probably also from peroneus longus). Hypertrophy of these muscles, the tibialis posterior being especially stressed by Manouvrier and Charles (1888 and 1894), accompanies increase in the posterior surface of the tibia seen in frequent diamond shape shaft section and in relative platycnemia.

All of these postural details as well as the whole body build picture fits closely the pattern observable in late sixth or early fifth century vase-paintings and sculpture.[11] And I cannot tell how far this subconsciously may have influenced my interpretation of skeletal detail.

One more skeletal detail may possibly form part of this posture complex. This is the bilateral occurrence in two males and seven females of an eroded area on the antero-superior surface of the femoral neck exposing the inner trabeculae of the neck and surrounded by a varyingly emphasized bony rim or rampart apparently caused by irritation of the periosteum and synovium. Described as the cervical fossa of Allen this has been considered by Poirier to be an acetabular imprint (Meyer, '24) and has been ascribed to rubbing by the ilio-psoas tendon, but more probably results from erosion by the thick anterior portion of the zona orbicularis of the hip joint capsule according to Odgers ('31). Perhaps this rubbing occurs through over-tension of the ilio-femoral ligament in combined extension and external rotation of the thigh. Such a position is an awkward one and might occur only in the trailing leg during descent of talus slopes.

[10] Not to be confused with Charles' facet (1894) which does not occur among the Greeks. Poirier's facet on the neck of the femur is uncommon among Greeks. Both these are developed by squatting.

[11] In photographs of Hege ('36, pp. 25–80, 41) and of Buschor ('36, p. 47) emphasis is striking on lateral abdominal, gluteal, calf, and anterior thigh muscles, and bent knees and ankle hyperflexion are not lacking in representations of action.

Some details in this synthesis of topography (cf. Frantz and Talcott, '41), modern gait, muscle function, and skeletal peculiarities will undoubtedly prove incorrect: available skeletons are too few for certainty. But at least we can be sure that the Greeks were stockily robust in build with a more flexibly springy gait than in modern city dwellers or plainsmen.

Sex differences

These are perfectly normal for whites. The female pelvis retains the relatively large size of the Greek male though smaller externally. It is marked by much wider and shallower sub-pubic angle and ischiatic notches, much more excavated pre-auricular sulci, and much larger pelvic inlet and outlet diameters. These are the only really reliable sex differences noted as in the study of Young and Ince ('40) on English pelves. The only apparent sex difference in the sacrum is a female trend toward the hyperbasal type. Lack of funneling in the female pelvis is clearer in the least bi-ischiatic than in the less easily measured interspinous breadth. As suggested by Greulich and Thoms ('38, '39) the female inlet is relatively as deep as the male. But neither sex reaches the relative inlet depth suggested by derived x-ray measurements of Young and Ince ('40) or index percentages of Greulich and Thoms. In inlet morphology Greek females show a smaller percentage of narrow oval, relatively android, pelves than expected according to Caldwell and Moloy's percentages (quoted by Young and Ince, '41).

Female long bones show the expected decrease in size and robusticity, with smaller joints, and apparently with shorter arms compared to legs. But they share the male stockiness. Except for less femoral torsion, with slightly sharper lumbar curve to balance greater separation of sacro-iliac joint from acetabulum, the females repeat Greek male peculiarities of posture and gait.

Anomalies and pathology

High frequency of six segment sacra is notable, especially in males among whom the sixth vertebra tends to be lumbar. In three (and possibly four) out of eight males where the first sacral vertebra is markedly lumbar in form a vertebra has been eliminated either from thoracic or lumbar regions. This is true of the single female where the fifth lumbar has been sacralised, and was possibly true of the other four males. This shows a tendency for the pelvis to climb up the spine, though the opposite trend is obvious in minimal degree (no presacral vertebrae being added) in cases of sacralisation of the first coccygeal generally with hypobasal sacrum. There are no cases of partial fusion at the lumbo-sacral junction and only two (28 AA a Mycenaean male and 2 Ce a Cephallenian female) of enlarged fifth lumbar transverse processes bilaterally touching the sacral alae.

Thirty per cent of males and 6% of females have fused transitional vertebrae and not more than 5% of each sex show any other form of transition. Dubreuil-Chambardel ('25) records the former in .9% of males and .3% of females, and the latter in 10% males and 4% females. Breck, Hillsman, and Basom ('44) estimate the latter at 8% in healthy males; fifth lumbar sacralization may occur in a fraction of their 9% with lumbar ribs (4 true lumbars) estimable at from .7% (Willis, '23) to almost 3% (Lanier, '39, pp. 398, 412. Schultz, '30, p. 318) in adequate series. Young and Ince ('40 a) find 2.5% of females with bilateral fusion of fifth lumbar to sacrum and smaller percentages with fusion of first coccygeal and lumbarization of first sacral (4-segment sacra). And Keith (quoted in Martin, '28, p. 1074) gives 3% and 5% of sacral incorporation of fifth lumbar and first coccygeal respectively. Hence ancient Greeks appear to sacralize the fifth lumbar unusually frequently, although the numbers are too scanty for certainty. In agreement with Rosenberg's hypothesis (Martin, '28, p. 1074) four lumbars occur twice (probably three times), eleven thoracics twice,

and a left cervical rib once. It is very hard to explain these tendencies except on a hereditary basis, like that of Kühne ('32) who finds craniad variation genetically dominant (cf. also Sawin, '45).

As expected the males are more unstable than females in the lumbo-sacral transition, and similarly the pathologies listed in table 5 are practically limited to males partly because of the sex difference in age at death. All fractures show good functional union except a fracture of the femur illustrated by Fürst ('30, p. 123). There is a single case of congenital hip dislocation and three of wedgelike compression of vertebral bodies suggesting a frequency not far from the 9% found by Breck et al. ('44). Degenerative arthritis obviously is the chief bone pathology. Its frequency on the vertebral column alone is 33% in males compared with Breck's ('44) estimate of 21% for American males engaging in heavy labour. Severity of arthritis ranges from perceptible osteophytes rimming vertebral centra or laminae to dense ossification of all laminae of the anterior longitudinal ligament on the right side, with ankylosis from fifth to eleventh thoracic vertebrae, in a Classical Athenian (65 AK). Comparable spondylitis deformans occurs in the Middle Bronze Age (Fürst, '30, p. 122) and is identcial with Ruffer's observations for Early Dynastic Egypt (quoted in Moodie, '23, pp. 403–404).

Types

All-importance of environment was assumed in discussing posture. This may appear exaggerated. Hence before considering chronological changes which may also have environmental explanations I shall deal with heredity. A generalized idea of hereditary differences may be reached from morphological types derived in previous papers (Angel, '42, '44) from the mass of Greek cranial material. Although such types are artificial condensations of presumably genetically determined similarities and hence are no more real than is any "average," they are convenient symbols.

Table 3 illustrates male skeletons selected according to grouped cranial types. Partly because small numbers compelled combination of several more or less similar skull types the differences between the three groups are not great. The generalized Mediterranean group with mean somatotype 2.6 – 3.4 – 4.3 on thirteen skeletons could be interpreted as of relatively slender build, gracile, with narrow and deep pelvis, short waist, long forearms and shins, and small feet.

T A B L E 3
Mean measurements and proportions of three male skeletal subgroups determined by cranial morphological types established for ancient Greeks

	MEDITERR-ANEAN		NORDIC-IRANIAN		ALPINOID	
Diameter	Mean	N	Mean	N	Mean	N
HUMERUS						
Max.length	308.1	8	313.7	9	304.3	10
Max.middle	21.7	12	23.0	9	22.1	11
Min.middle	16.8	12	18.0	9	17.4	11
R A D I U S						
Max.length	232.5	10	240.4	9	232.9	6
CLAVICLE						
Max.length	140.7	7	152.4	7	140.6	4
F E M U R						
Max.length	431.4	13	446.9	12	423.2	14
Max.d.head	45.2	12	47.0	9	47.5	10
Subtr.A-P	25.3	14	28.2	9	25.6	13
" lateral	32.0	14	33.2	9	33.9	13
Middle A-P	28.4	14	29.9	9	28.4	13
" lateral	26.7	14	28.2	9	27.4	13
T I B I A						
Diag.length	352.7	11	356.3	11	340.6	10
N.f. A-P	34.0	14	36.0	9	34.5	11
N.f.lateral	21.7	14	24.7	9	23.1	11
CALCANEUS						
Max.length	77.6	7	82.4	10	80.2	7
P E L V I S						
Innom. ht.	206.1	5	212.2	9	210.9	6
Innom. br.	153.6	7	160.2	8	160.7	4
Bi-iliac br.	247.0	2	278.6	7	275.6	4

	MEDITERR-ANEAN		NORDIC-IRANIAN		ALPINOID	
Diameter	Mean	N	Mean	N	Mean	N
P E L V I S						
Intersp.br.	91.2	4	88.0	6	90.0	3
Inlet br.	123.2	5	124.7	7	130.2	5
Inlet A-P	102.5	3	100.3	6	102.7	4
LUMBARS						
Ant.hts.	130.5	4	138.8	8	139.2	5
Post.hts.	125.5	4	138.6	8	132.0	5
STATURE	162.5	17	163.9	14	160.0	16
I n d e x						
BODY BUILD						
Humero-radl.	76.6	7	76.2	8	75.4	5
" -clavic.	47.1	5	48.4	6	45.9	3
Femoro-huml.	72.2	6	71.7	7	71.5	6
" -tibial	82.1	8	81.6	10	82.1	9
Robusticity	12.8	12	13.0	9	13.0	8
INTRAMEMBRAL						
Hum.flatness	77.2	12	78.4	9	79.1	11
Platymeric	79.0	15	83.2	11	75.5	13
Pilastric	105.6	15	106.2	10	101.7	13
Cnemic	68.7	15	68.3	10	67.4	11
Talus l-ht.	57.0	6	60.0	9	57.6	7
Pelvic inlet	85.2	3	80.4	6	78.6	4
Sacral ht-br	90.4	4	99.2	6	108.7	3
Lumbar	96.1	4	100.0	8	95.0	5

Note : The subgroup labelled "Mediterranean" is determined by skulls of gracile Mediterranean, rugged Basic White, and Dinaric-Mediterranean types (Types B, A, and F). Skulls of both Alpine and Mixed Alpine types select the Alpinoid skeletons (Types C and E), and the Nordic-Iranian group derives from skulls of that type alone (Type D).

With mean somatotype 3.3 – 4.3 – 3.2 (9) the Nordic-Iranian skeletal group might be marked by large body with broad shoulders and capacious funneled pelvis, with long leg bones thickened anteroposteriorly, relatively straight lumbar region, and big feet with high tali. Suiting somatotype 4.1 – 4.0 – 2.4 on eleven skeletons the Alpine skeletal group might be small sized, stocky, and solid, with relatively broad pelvis and narrow shoulders, robust long bones, flattened femora and tibiae, and sharp lumbar curve. But none of these divergences can be significant with present data though all will be worth

testing when an adequate mass of Greek skeletal material is available. For the sake of interpreting chronological change I shall consider four peculiarities real: Mediterranean gracility, Nordic-Iranian tallness and breadth, Alpine shortness, and Alpine platymeria.

CHRONOLOGICAL CHANGE

Because of small numbers only three chronological subgroups can be outlined in tables 4 and 5. These are the prehistoric group of skeletons dating from the first occupation of mainland Greece to the end of the Bronze Age, the historic group of Classical times and later, and the intermediate group from the Early Iron Age transitional period. The prehistoric group is particularly composite [12] because it spans action on a small population of a series of relatively marked racial, ethnic, cultural, and even environmental changes. But some changes are demonstrable anyway.

The most striking trend is marked increase in body size, statistically significant for all long bones and for stature. This amounts to over 8% for males and somewhat less for females.[13] And it parallels slight increase in head size over expectation from the third millennium B.C. onward. This is just perceptible in horizontal circumference (which significantly decreases in Byzantine times) and clearer in basion-nasion length (Angel, '44) though neither increase is statistically significant.

Almost as striking is the significant relative shortening of tibia and lengthening of radius, interpretable further as an historic period lengthening of upper relative to lower extremity.

[12] Sigmas for maximum femoral length are 34.7, 19.3, and 17.8 for the three successive period groups, where increase rather than decrease would be expected to accompany gross size increase. But the decrease parallels the drop in cranial variability after the typologically heterogeneous Middle Bronze Age.

[13] Female stature averages are 150.7 (13), 154.1 (18), and 155.0 (13) respectively for the three successive period groups.

TABLE 4

Chronological changes in ancient Greek male skeletons, and mean measurements and indices of comparative series (right bones only)

Diameter	Neolithic to Mycenaean ca.3300 to 1150 B.C. Mean	N	Early Iron Age ca.1200 to 650 B.C. Mean	N	Classic to Byzantine 650 B.C. to 1300 A.D. Mean	N	Medieval Irish monks 600 to 1600 A.D. Mean	N	Americans & English Modern Mean	N	Martin definition no.
HUMERUS											
Maximum length	296.4	11	311.6	12	323.0*	11	332.1	64	326.2	378	1
Max. head diameter	43.3	7	46.3	10	47.2*	8	48.7	65			10
Max. mid-shaft "	20.4	9	22.4	15	22.3	18	24.1	81	23.2	304	5
Min. mid-shaft "	15.9	9	17.1	15	17.9	18	19.2	81	18.9	304	6
RADIUS											
Maximum length	222.9	6	231.4	11	244.8*	13	252.1	62	239.0	182	1
ULNA											
Maximum length	249.1	6	257.3	10	263.9	10	274.8	51			1
CLAVICLE											
Maximum length	141.2	8	140.3	6	150.5	7	151.6	58	152.9[1]	50	1
SCAPULA											
Breadth	99.0	4	106.2	2	106.7	7	104.5	21	107.0	70	2
FEMUR											
Bicondylar length	416.9	14	424.2	18	449.3*	10	453.8	74	457.8[2]	100	2
Maximum length	420.3	14	429.1	19	452.7*	13	456.7	72	460.9[2]	100	1
Max. head diameter	43.4	8	46.3	17	47.5*	15	48.4	78	48.6[2]	100	(18)
Subtrochanteric A-P	24.4	13	26.3	18	27.0*	19	26.0	83	27.1[2]	100	10
" lateral	30.9	13	33.9	18	33.1*	19	34.7	83	32.4[2]	100	9
Mid-shaft A - P	27.2	13	29.1	18	29.7*	19	30.5	81	29.3[2]	100	6
Mid-shaft lateral	26.3	13	28.1	18	28.1*	19	28.1	81	28.1[2]	100	7
TIBIA											
Diagonal length	335.2	10	352.4	14	363.3*	12	368.2	61	365.0		1
Nutr. for. A - P	34.7	9	34.4	16	35.5	19	36.6	76			8 a
Nutr. for. lateral	22.9	9	23.2	16	24.2	19	24.6	76			9 a
CALCANEUS											
Maximum length	78.1	8	81.0	10	81.6	9	83.4	57	83.3		1
Maximum breadth	41.7	8	42.4	10	43.4	7	44.2	62			2
TALUS											
Sulcus-head length	50.8	6	52.4	10	54.6	8	(60.7	62)			1
Transverse breadth	42.0	6	43.4	10	44.2	8	(44.7	61)			2
Projective height	29.2	6	30.0	10	33.1	8	(34.4	65)			3
PELVIS											
Innominate height	201.8	4	205.9	10	216.6	10	221.6	38	220.6	32	1
Innominate breadth	154.2	5	153.1	10	161.0	7	161.5	29	162.4[3]	100	12
Bi-iliac breadth	264.0	3	271.0	4	276.1	7	273.2	36	271.0	32	12
Least bi-ischial	153.3	3	143.8	4	144.0	7			150.4[4]	19	
Inlet breadth	124.5	3	124.8	5	126.7	9	127.6	50	120.8[5]	50	24
Inlet A - P	94 ?	1	101.2	5	105.8	9	101.9	22	115.1[5]	50	23
Interspinous br.	104.5?	2	91.3	4	84.3	7	85.9	16	82.9[5]	50	8
Sacral height	101.8	4	106.2	5	119.1	9	103.4	27	106.2	56	2
Sacral breadth	106.8	5	104.0	8	110.9	11	117.5	30	116.7	68	5 a
LUMBAR VERTEBRAE											
Anterior heights	137.6	5	130.3	7	141.3	7			137.3[6]	43	4
Posterior heights	131.0	5	127.6	7	141.3	7			131.8[6]	43	5
STATURE	159.4	19	162.0	24	165.4*	18	166.9	*	165.8	*	
Index											
BODY BUILD											
Humero-radial	75.9	6	74.5	8	76.6	10	76.0	52	73.8	182	
Humero-clavicular	49.1	5	45.9	5	47.2	5	45.5	45	45.4[1]	50	
Femoro-humeral	72.0	5	72.2	10	71.5	8	73.3	57	72.2	200	
Femoro-tibial	83.2	8	81.6	11	81.0*	9	81.4	59	82.0		
Femur "robusticity"	12.6	9	13.4	16	12.8	10	12.9	*	12.5[2]	100	
INTRAMEMBRAL											
Humeral flatness	78.1	9	76.5	15	80.7	19	79.7	82	81.6	304	
Platymeric	78.0	16	77.5	18	81.7	19	75.3	83	83.5[2]	100	
Pilastric	104.9	15	103.7	18	105.7	19	108.3	*	104.1[2]	100	
Cnemic	66.4	11	68.1	16	68.6	19	67.5	76			
Talus length-ht.	57.5	6	57.2	10	60.5*	8	(56.7	61)			
Total pelvic	75.9	2	78.8	4	78.4	7	79.0	9	81.4	32	
Pelvic inlet	79.7	1	79.3	4	83.9	9	81.3	22	90.8[5]	50	
Sacral ht.-br.	108.3	3	100.3	4	96.6	9	114.0	24	109.8[5]	50	
Vertical lumbar	95.4	5	97.9	7	100.1	7			96.2[6]	43	

Note : Authorities for modern American and English dissecting room material: Hrdlička; [1] Terry, '32; [2] Ingalls, '24; [3] Straus, '27; [4] Hooton and Reynolds, '36; [5] Young and Ince, '40a; [6] Todd and Pyle, '28. For the three Greek chronological groups the means of the two sides for each individual were used, whereas in the Irish and modern groups only bones of the right side have been used. Statistically significant differences of Early Iron Age and historic (Classic-Byzantine) periods from the preceding one are underlined. Significant differences between prehistoric (Neolithic-Mycenaean) and historic period groups are starred.

Historic period decrease in shaft flattening of both humerus and femur is significant and interesting. And the even clearer trend toward a high talus is still more puzzling.

But the most interesting change is the strikingly significant femoral thickening in the Early Iron Age, with subsequent return almost to prehistoric shaft slenderness.

TABLE 5

Chronological and sex occurrence of individuals with pathologies, and numbers of individuals represented by 1 - 3 bones, by incomplete, and by good skeletons

Pathology		Neol.-L.H.III	Early Iron	Classic-Byzantine	Males	Females	Both sexes
Apparent wounds		2	2	0	4	0	4
Fractures		2	6	4	10	2	12
Wedge-shaped vertebrae		1	2	0	3	0	3
Periostitis		2	2	1	4	1	5
Miscellaneous		0	hip 1 dislocation	1 larynx calcified	1 larynx	1 hip	2
Spondylitis deformans		2	0	1	3	0	3
Degener-	of spinal column	5	4	3	11	1	12
ative	of long bones and pelvis	6	5	3	11	3	14
arthritis	of hands (rheumatoid)	1	2	0	3	0	3
All arthritic individuals		10	7	5	19	3	22
All individuals represented		40	52	39	79	53	132
Incomplete skeletons		10	23	31	41	23	64
Well-preserved skeletons		4	15	12	18	13	31

Note : it is not possible to calculate percentage frequencies of pathology because of the very small number of complete or almost complete skeletons : less than a quarter of the total number of individuals represented by at least one bone.

Certain other chronological trends are not significant but seem plausible. These include pelvic deepening with possible sacral lengthening; lumbar curve straightening; tendency toward eurycnemia, with lessened tibial head retroversion and less frequent squatting facets; and less diverted and more vertical head of the talus.

In summary the average prehistoric Greek was short and relatively lightly built, perhaps with broad shoulders relative to hips and with some flattening of the long bone shafts. A mean somatotype of 2.8 – 3.2 – 3.9 on six individuals stresses slenderness, lightness, and lack of marked robusticity.

The Early Iron Age build is markedly stocky, robust, probably broad-hipped, with definite flattening of long-bone shafts (especially humerus and femur), and a congruent mean somatotype of 3.5 – 4.1 – 3.0 on thirteen skeletons. The historic period average has medium stature with relatively long forearms, medium robusticity, more rounded long bone shafts, higher foot, and probably less marked relative hip breadth with deeper pelvis. On fifteen men the mean somatotype is 3.3 – 3.9 – 3.4, slightly less linear and more robust than modern Americans and differing from early Fifth Century artistic standards only in being less showily mesomorphic.

As interacting causes for these chronological changes I shall consider three separate factors: diet and hygiene, heredity, and postural habits.

Dietary change

During the prehistoric period food habits changed considerably from those of inefficient hoe-farmers supplementing their cereal diet (Hansen, '33, p. 47) with fish and flesh of wild as well as domestic animals (Shear, '38, p. 336), to those of the plough-using, wine-drinking, beef- and cheese-eating Homeric heroes (Seymour, '08, pp. 331, 213–234). In general wheat and more often barley were staple foods from the Neolithic onward as well as lentils, peas, acorns, almonds, figs, pears, and oysters (Hansen, loc. cit. and Wace and Thompson, '12, pp. 53, 149, 262), and green herbs. Grapes (Mylonas, '34) and presumably currant grapes which have a pre-Greek name, were introduced during the Early Bronze Age. The same may be true of the olive. The plough probably was not brought in from Crete until Middle Bronze Age (Robinson, '31, p. 156).

In later times dietary scope increased only slightly to include the chicken, green vegetables such as cabbage, onions, or cucumbers, and fruits like apples, plums, quinces, and dates (Michell, '40, pp. 74, 55). But agricultural methods improved during the Early Iron Age by extension of

Homeric crop rotation, manuring, and irrigation (Seymour, '08, pp. 329–330, and Michell, '40, p. 49 ff.), and importation of grain allowed the historic period rise in population (Jardé, '23, pp. 260–265).

Hence the actual foods eaten are less important in dietary change than improvements in farming methods and obviously the actual amounts of food available per capita at different periods (to which there are few clues). That undernourishment of much of the prehistoric population resulted from inefficiency of hoe agriculture is suggested by osteoporosis in twelve out of forty-nine third millennium B.C. skulls. This deficiency disease does not reappear until Byzantine times. Introduction of relatively efficient plough agriculture occurred only late in the Bronze Age making possible better use of Greek calcium rich soil. But only 25% of Greek land has ever been cultivable (Jardé, '23, p. 59). And optimum diet for the average man could not have been available until grain importation provided the staple food. Paralleling this rise in nutritional standards archeological remains show a general rise in civilized comfort and hygiene for the rulers during Mycenaean times and later for the bulk of the population. Decline of dietary and living standards during the Middle Ages is of no interest in this study since present skeletal data are too scanty for comparisons.

It seems clear, therefore, that improvement in nutrition accompanied and largely caused the observed increase in body size (cf. Krogman, '43). Optimum nutrition also gives adequate bone surface for muscle attachment without need for shaft flattening to increase surface relative to mass (cf. Buxton, '38). And much of the decrease in shaft flatness must result from dietary improvement.[14]

[14] Bowles' ('32) finding that relative shin shortening with forearm lengthening (and hence relative span increase) have accompanied modern American stature increase suggests that improved nutrition may account for this and the parallel change in the historic period Greek group through heterogony (Huxley, '32, pp. 8, 6, 83–90, 201): the existence of diverse growth rates and gradients through which a mammal's adult proportions are determined by the gross size it is able to reach at maturity. For instance, stunted mammals tend to retain juvenile

Heredity seen in type change

Smooth period to period change in skull measurements from third millennium B.C. onward reveals essential genetic continuity in Greece (Angel, '44) with continuity of historical processes of migration and selection. Morphological type percentages and measurements agree in showing a central genetic trend from a generalized Mediterranean norm (gracile Mediterranean plus rugged Basic White) in an Alpine direction (headform change) with certain Dinaroid details (nose lengthening) and other, unnamed, genetic recombinations (jowl broadening). This process is not steady, but shows especially in type frequencies a series of cyclic fluctuations around the central trend. Generalized Mediterranean dominance of third millennium, Mycenaean, and Classical groups alternates with dominantly Alpine and hybrid Alpine (Dinaric-Mediterranean and Mixed Alpine) complexes in Middle Bronze Age, Early Iron Age, Roman, somewhat in Byzantine, and again in modern times. The Nordic-Iranian type plays a variable part mostly in the latter complex though also in Classical times.

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proportions. But Shapiro's ('39) Hawaiian-born Japanese differ from their immigrant parents in shin lengthening (as well as hip-narrowing) significant in the males (Shapiro, '39, pp. 40–41, 46, 101, 190) and linked with environmentally determined stature increase. Shin lengthening is the expected proportion change with ontogenetic growth (Martin, '28, pp. 418–419. Schultz, '26, p. 514), though the expected forearm shortening does not occur (Martin, '28, p. 396. Contrast Schultz, '26, p. 489, foetal-adult forearm lengthening) and since shin lengthening is already incipient among the Japanese immigrants factors of selection through migration (Shapiro, '39, pp. 200–201) may be active. Thus my own and Bowles' data diametrically oppose the proportion change expected through heterogony with size increase, and Shapiro's data agree only partly with this hypothesis. Huxley stresses ('32, pp. 83–90, 232–234) genetic control of growth rates which could change an expected heterogonic relationship. Hence either different human breeding groups must have radically different proportion change during growth, an unlikely hypothesis (Schultz, in Martin, '28, pp. 269–280, finds small though typical racial differences in foetuses), or else genetic factors have modified growth gradients just before maturity among the modern Americans and ancient Greeks observed. In the ancient Greek proportion changes, therefore, genetic recombinations (a "Dinaric" trend?) are more important than heterogony.

From this situation we expect a medium-tall variably slender prehistoric body build followed by Early Iron Age stocky shortness with marked platymeria to be succeeded by a tall, broad, less robust and less platymeric Classical period body standard. But increasing Alpine stubbiness and platymeria should follow this and in the total historic period group should cancel the Classical period's features. This prediction fits the facts of table 4 only irregularly: probably shortness, robusticity, and shaft flattening of the Early Iron Age do

TABLE 6

Simplified estimates of proportionate influence of various factors in development of chronological trends and fluctuations in ancient Greek skeletal material

Trend or change	ENVIRONMENT			HEREDITY
	Nutrition	Living conditions	Walking habits	Morphological type effects
Body size increase	extreme	v. slight	-	slight
General increase in roundness of long bone shafts	marked	-	slight	v. slight
Decrease in incidence of arthritis	medium	marked	v. slight	- ?
Probable deepening of pelvic inlet	medium	v. slight	-	v. slight
Change in platymeria	medium	-	slight	slight
Probable lumbar straightening, knee, ankle, foot changes	-	-	medium	- ?
Relative shin shortening and forearm elongation	? (heterogony ?)	-	slight	marked
Fluctuating robusticity (Early Iron Age most robust)	-	-	v. slight	marked
Probably changing body build (e.g. somatotypes)	- ?	-	-	medium

have a partly genetic basis as indicated in table 6. Conceivably this also applies to historic period shin shortening and forearm lengthening, which parallel exactly the body proportion changes reported by Bowles ('32) to accompany modern American stature increase. On the whole, discrepancies between the predicted picture and table 4 stress nutrition as far more important than heredity in determining body size, partly also the roundness of long bone shafts, and conceivably pelvic deepening.

Cultural habits and posture

Seymour ('08, pp. 256, 267) stresses the high status of manual labour in Homeric Greece. By the end of the Early

Iron Age with increased slave labour this Homeric attitude toward exertion and comfort may have changed just enough to lessen postural adaptations to steep slopes. Decrease certainly in platymeria and talus lowness, and possibly in platycnemia, tibial retroversion, squatting facets, lumbar curve, and primitive foot features all may reflect change in habits. Social selection would intensify this effect, since at all periods grave customs tended to exclude the lowest economic group.

Change in pathology

Table 5 gives raw frequencies of individuals with various types of pathology. Though it is impossible to work out accurate percentages it is obvious that in this material there is a decrease in occurrence of arthritis from prehistoric to historic times, presumably linked with improved general living conditions. Except for fractures the other categories show no other trend.

OUTSIDE COMPARISONS

Except for the northwestern groups in table 4 there is little data beyond stature reconstructions available for comparison with Greek data in table 4. According to Duckworth ('03) Minoan males averaged about 159 cm., almost identical with contemporary central Anatolians from Alişar Hüyük (Kansu, '39) and no taller than mainland Greeks. But Egyptians at 167.5 (Warren, 1897. Coon, '39, p. 95), North Iranians at 165.4 (Krogman, '40, p. 31), Cypriotes at about 165 (Fürst, '33, p. 79), Siculans at about 169 (Coon, '39, p. 147) and Danubians of late Neolithic and Aunjetitz date at 164 and 167 cm. (Coon, '39, pp. 108, 164) all exceed the prehistoric Greek stature. Shortness comparable to that of prehistoric Greece has occurred in modern Europe only in regions of environmental depression such as the Limousin hills in southwest central France (Coon, '39, p. 515, after Collignon).

Although post-Hittite Anatolians at 161.5 cm. (Kansu, '39) are no taller than Early Iron Age Greeks, the latter are

shorter than Etruscans at 165 cm. (Cipriani, '29) and no taller than modern Sardinians at 162 cm. (Coon, '39, p. 500).

Historic period Greeks equal or exceed their Anatolian contemporaries at 165.4 and 162.4 cm. for Hellenistic and Byzantine dates (Kansu, '39) and approximate Gauls and medieval French (Rahon, 1893, and Coon, '39, p. 191). But these Greeks are shorter than Hallstatt Nordics at 168 (Coon, '39, p. 183), Hallstatt-LaTène Illyrians at 170 (Angel and Hencken, unpublished data), Bajuvars at 168.8 (Breitinger, '38), Medieval Norwegians at 168 cm. (Wagner, '26), Irish, or other northwestern groups with Upper Paleolithic or Nordic backgrounds.

If the Pearson stature formulae give valid predictions of living stature historic period Greeks would be as tall as modern North Italians, West French, or North Spanish and Basques (Coon, '39, pp. 556, 514, 502, 252). But these formulae probably underestimate stature (cf. Ingalls, '24) in Mediterranean as well as more northern regions. With regressions based on 2400 living German males averaging 26 years old Breitinger ('38) has shown that Pearson's formulae underestimate for Reihengräber series by 2 cm. or slightly more. Together with the fairly close approach of historic Greek to modern American skeletal diameters [15] this suggests that historic period Greeks were as tall as modern Greeks [16] though there was probably an intervening period of shorter stature associated with relative impoverishment.

Hence at all periods the ancient Greeks were on the short side of medium. But the amount of their stature rise and its rapidity from 800 to about 500 B.C. exceeds that found elsewhere (cf. Rahon, 1893, and Bowles, '32) except for ancient Anatolia (Kansu, '39) and parts of modern Central

[15] Hrdlička's material ('16, '32), obtained from people dying around 1900 A.D., fails to equal modern American body size clearer in Terry's ('32) and Ingalls' ('24) data presumably derived more recently.

[16] Coon, '39, p. 605, 252. I obtained a stature of only 165.5 cm. on a group of 37 living males from Central Greece measured almost entirely in the afternoon. Probably a slight underestimate.

Europe (cf. northwest Switzerland mentioned in Coon, '39, p. 549) where environmental change in modern times is obvious. Chronological change in shaft flattening, tibial head retroversion, femoral pilastering, etc. has been attributed elsewhere to various environmental mechanisms (Manouvrier, 1888, 1893) not always congruent with those suggested in table 6 for Greeks.

CONCLUSIONS

Table 6 rates environmental factors far more important than genetic ones [17] in determining general body size. Yet heredity cannot be ignored when such changes as ancient Greek shin shortening and forearm lenghtening parallel a change in body size. The modern stature rise supports this conclusion as do Bowles' ('32) father and son data where heredity is partly controlled yet where changes in proportions and relative weight also occur through genetic recombination and heterogony.

Through both diet and posture environment almost exclusively determines relation of surface to mass (flatness or roundness) of long bone shafts, though with possible added genetic influence.

Incidence of arthritis depends mainly on environment.

Body build, particularly as seen in femoral robusticity, is less environmentally than genetically determined.

Hence in any time-sequence study environmental effects must be checked very carefully. This applies more stringently to skeletal, somatic, or dental studies than to purely cranial ones.

[17] Hybrid vigour may cause a small fraction of ancient Greek size increase (cf. Shapiro, '29, p. 69), though this cannot be tested. The cranial material shows the Greeks to have been an outstandingly hybrid people from the third millennuim B.C. onward (Angel, '44), with particularly vigorous phases of mixture during the transitions from Middle Bronze Age to Mycenaean and from Early Iron Age to Classical (possibly also at the end of the Byzantine period?). Since period groups used for skeletal material are too inclusive to distinguish stature changes linked with these peaks of hybrid vigour, I can only suspect that this may have played a part in the rapidity of stature increase at the beginning of historic times.

All these conclusions rest on correlation of biological with social data. Considering the present environmental destruction in Europe, China, and the western Pacific no biologist, historian, or statesman can afford to ignore such correlations.

SUMMARY

1. Ancient Greeks in general were medium to short in stature (162-163 cm. males, 153–154 cm. females), fairly muscular, with a stocky European type of body build.

2. Asymmetries and sex differences are normal. Pelvic sex criteria agree with modern x-ray studies.

3. Review of posture dynamics suggests connection between slippery mountainsides and such skeletal details as iliac flare, platymeria, tibial retroversion, diamond-shape tibial cross section, squatting facets, through a need for pelvic balance, bent knees, and hyperdorsiflexion of the foot.

4. Parallel chronological change suggests connection between improvement in nutrition and living conditions and statistically significant size increase and rounding of long bone shafts, and apparent diminution in arthritis.

5. Fluctuations in morphological type dominance parallel significant changes in femoral robusticity (and body build), and in limb proportions, suggesting prime influence of heredity in these skeletal changes.

6. Significant decrease in platymeria and rise in talus height, and possible changes in lumbar curve, knee, ankle, and foot accompany increase in slave labour with possible decrease in heavy physical exertion among the economic groups predominating in tombs of all periods.

7. Ancient Greek size change, most rapid over a period of a few centuries, exceeds in general that of the past century among civilized peoples.

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FRANCIS BACON ON BODILY VARIATION.— In the Second Book of his Proficience and Advancement of Learning, Lord Bacon (1560–1626) thus complained of the anatomy of the time. "In the inquiry which is made by anatomy I find much deficience: for they inquire of the parts, and their substances, figures, and collocations; but they inquire not of the diversities of the parts, . . . As to the diversity of parts, there is no doubt but the facture or framing of the inward parts is as full of differences as the outward. . ."

THE "GUINEAS" OF WEST VIRGINIA.— We are accustomed to think of West Virginia as a racially homogeneous State populated by Old Americans of English, Scotch, and Scotch-Irish descent with an additional contingent in recent years of Poles and Italians in the mining areas. It may come as somewhat of a surprise to many to learn that there exists in the northern counties of the State a racial island of mixed bloods, known locally as "Guineas," numbering several thousand persons. The origin of this mixed race is unrecorded, and the relative proportion of white, Negro, and Indian blood entering into its makeup is difficult to ascertain. The main seat of this people is in northern Barbour County and southern Taylor County, but small groups are to be found in over half a dozen adjoining counties and in Garrett County, Md. From their homes in the hill country many have gone in recent years to the factory cities of West Virginia, Ohio, and Michigan in search of economic opportunity and social betterment.

There can be little doubt that the Guineas, in common with the Wesorts of southern Maryland and the Croatans of North Carolina are another example of the triple racial admixture of Indian, Negro, and white to be found in a number of places in this country where circumstances have favored their development. Only a detailed anthropometric analysis at some future date will yield the evidence for physical typology and the relative proportions of each group. Several of the Guinea genealogies refer back to full-blood and half-blood Indian ancestry, but the entry of Negro blood into the group is not recorded.

According to local white opinion the habit of inbreeding has weakened the Guineas. Several informants mentioned the deformities of the joints, especially of the arm and leg joints, as occurring at birth among them in a number of instances. Among other defects mentioned as occurring are bad hearing, poor sight, harelips, humpbacked conditions, and mental deficiencies and aberrations. — William Harlen Gilbert, Jr. Mixed bloods of the Upper Monongahela Valley, West Virginia. J. Washington Acad. Sci., vol. 36, 1946, pp. 1–13. (See also, The Wesorts of southern Maryland: An outcast group. J. Wash. Acad. Sci., vol. 35, 1945, pp. 237–246).

A NEW RULE FOR PREDICTING THE OCCURRENCE OF MULTIPLE BIRTHS

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For almost 25 years the numerical relation between single and multiple births has been under discussion. The question is whether or not the proportion $1{:}n$, n being the number of births corresponding to one set of twins, is indicative of the proportion of triplets, quadruplets, quintuplets or sextuplets to all births. According to the rule connected with the names of Hellin (1895) and Zeleny ('21), the proportions of these multiple births are $1{:}n$, $1{:}n^2$, $1{:}n^3$, $1{:}n^4$, and $1{:}n^5$.

Most authors have rejected the Hellin-Zeleny rule, claiming its inconsistence with the actual figures. Recently H. H. Strandskov ('45) has expressed this opinion on the basis of the U.S. birth statistics for 1922–1936. In these years, the registered number of triplets was 11.8% below the figure expected according to the formula, whereas the number of quadruplets was 23.2% above expectation. These are substantial discrepancies.

Only complete statistics can be used as a test for or against the rule. In 1922–1936, the birth statistics were not complete. To a smaller degree this is true also for more recent times. The improvement is gradual. In 1925–1930 n was 86, in the first quinquennium of the 1930's n was 87, and in 1939–1940 n was as high as 93. Comparing these years with 1922–1936, the disagreement between expectation and actual number of triplets and quadruplets diminishes considerably; in 1939–1940 there is an actual deficit of 2.6 and 16.7% respectively. However, one should not think that it is only the incompleteness of registration which causes deviations between expected and actual figures. There are also other reasons.

Hellin-Zeleny's rule has always been puzzling to statisticians. Usually, if $1:n$ represents the chance of a phenomenon occurring once in a group of n persons, $1:n^2$ and $1:n^3$ indicate the chance of the same phenomenon repeating itself twice and three times, respectively, in one individual. However, in the rule under discussion, $1:n$, $1:n^2$, $1:n^3$. . . , denote the occurrence of different phenomena in different persons of the group. As Pearl ('39) expressed it, this is "curious."

The deviations of the actual figures from expectation must not obscure the fact that the Hellin-Zeleny rule comes pretty close to reality. Neither should the rule be condemned just because it cannot be explained. On the contrary, correction and explanation should be tried. Indeed an amplification of the rule is necessary, because some women have a history of more than one twin delivery, or a record of twins and triplets, and so on. How frequent these and other combinations are, is not known. Neither the official births statistics, nor hospital records supply this information, and the expectation of these combinations in a woman cannot be estimated on the basis of the Hellin-Zeleny rule.

The purpose of this paper is to propose a new rule which seems more logical and covers the whole field of multiple births. In the new rule the unit of calculation has been changed from births (n) to mothers who have passed the age of reproduction (m). Thus, if $1:m$ is the ratio of mothers past the age of reproduction, among whom one has borne twins, then $1:m^2$ indicates the ratio of women among whom one has been delivered of two pairs of twins, and $1:m^3$ indicates the ratio of women of whom one has been delivered of three pairs of twins. Used in this way the unit of calculation m would seem to be the key to all birth combinations and hence surpasses in value the unit n which fails in estimates of the repetition of one phenomenon in one woman.

In the course of my studies on mortality since the renaissance (Peller, '43, '44) I have collected material on ruling families. These include 1610 mothers and 8,506 children, among whom are 85 certain and 2 probable pairs of twins

borne by 81 and perhaps by 82 women. For one woman the record is explicit with regard to 1 pair of twins, but leaves doubt as to a probable second pair. In this sample, m is equal to 1610 divided by 81 or 82; that is, to approximately 19.75 mothers. On this basis m^2 would equal 390. In other words, provided there is no heavy hereditary tendency in the sample to repeated delivery of multiple births, of 390 mothers one would have had twins twice. Dividing the total number of fertile women of the ruling families by 390, we obtained 4.13 mothers. Actually, four sure cases are recorded. In a fifth case, as mentioned above, it is probable that the mother of 1 pair of twins also had delivered a second pair.

Using the unit m as here defined, and denoting the average number of children per fertile woman by c, we can construct the geometrical series $m, m(m\cdot c), m(m\cdot c)^2, m(m\cdot c)^3, m(m\cdot c)^4$ which will serve as the basis for all estimates of multiple births. In this series, the initial term indicates the number of mothers among whom one has been delivered of twins; the second term refers to mothers of triplets, the third to those of quadruplets, the next to quintuplets, and the last term indicates the number of mothers among whom one has borne sextuplets.

The value of $m\cdot c$ is close to that of Hellin-Zeleny's unit n. Thus, in the sample of ruling families, $m\cdot c = 104.3$, whereas $n = 98.9$ births. (In the U.S.A. in 1939–1940, $n = 93$). In the ruling families $m\cdot c$ surpasses n by 5.5%. This seems a negligible difference, but it increases rapidly when instead of n^2, n^3, n^4 and n^5 the corresponding $m\ c$ values are employed.

According to the literature, the usual value of m is one in 20–25 mothers, the range being between 14 and 33. In other words, one in 14 to 33 mothers produce multiple births. As to c, according to general experience, it may be as high as 6 and as low as 3 children, but rarely lower.

Being a function not alone of c, the value m increases either proportionally less or more than the average number of children, c, diminishes. Occasionally both c and m may change in the same direction,that is, the average number of children per

fertile marriage and the number of women of whom one had been delivered of multiple births, may increase or diminish at the same time. These interrelations, especially the difference between $m \cdot c$ and n, account for the discrepancies between the actual occurrence of high litter sized multiple births and the expectation calculated according to Hellin-Zeleny. (Another reason for discrepancies has already been mentioned, namely, incomplete recording of all, as well as of the multiple births.)

Setting $m \cdot c = p$, we may rewrite the series $m, m(m \cdot c), \ldots$ in the following simplified form: $m, m \cdot p, m \cdot p^2, m \cdot p^3, m \cdot p^4$. This series contains all elements necessary for calculating the frequency of any kind of multiple births and of any combination of them of equal or unequal litter size as well.

Thus, according to chance, m^2, m^3, and m^4 represent the expected frequency of mothers of two, three or four pairs of twins respectively. The square of the second term of the series, namely $(m \cdot p)^2$, points at the expected frequency of mothers of two sets of triplets. The product of both the first and second term, $m(m \cdot p) = m^2 \cdot p$, gives the expected number of mothers of a pair of twins and a set of triplets.

Since, according to this key, $(m \cdot p)^2 = m(m \cdot p^2)$, mothers of two sets of triplets should be about as frequent as mothers of one pair of twins plus one set of quadruplets. Similarly, $m^2 \cdot p^3$ might result either from $(m \cdot p)(m \cdot p^2)$ or from $m(m \cdot p^3)$, implying that a woman's chance to become a mother of triplets (symbolized by $m \cdot p$) plus quadruplets (symbolized by $m \cdot p^2$) is equal to that of delivering twins (m) plus quintuplets $(m \cdot p^3)$. As a further example, the value of $m^4 \cdot p^2$ may be chosen. It is the product either of $m^3(m \cdot p^2)$ or of $m^2(m \cdot p)^2$, thus indicating that mothers of three pairs of twins plus one set of quadruplets should be encountered as frequently as mothers who twice have borne twins and twice triplets.

Knowing the values m and c, we can calculate all the combinations of multiple births and present them in the order of the frequency to be expected. Thus, on the assumption that

in a population m is equal to 20 and c equal to 4, table 1 has been calculated.

For testing some of these formulas a thousand or a few thousand families are an adequate sample. It should be easy, for instance, to find out whether in a population with m equal to 20 and c equal to 4, mothers of triplets are about five times

TABLE 1

Possible combinations of multiple births and their predicted frequency of occurrence by the new rule, assuming $m = 20$, $c = 4$, and $p = m \cdot c$.

BIRTHS	FORMULAE		FREQUENCIES
Twins, once	m	=	20
Twins, twice	m^2	=	400
Triplets, once	$m \cdot p = m^2 \cdot c$	=	1,600
Twins, three times	m^3	=	8,000
Twins and triplets	$m^2 \cdot p = m^3 \cdot c$	=	32,000
Quadruplets	$m \cdot p^2 = m^3 \cdot c^2$	=	128,000
Twins, four times	m^4	=	160,000
Twins, twice and triplets	$m^3 \cdot p = m^4 \cdot c$	=	640,000
Triplets, twice or Twins and quadruplets	$m^2 \cdot p^2 = m^4 \cdot c^2$	=	2.6 million
Twins, five times	m^5	=	3.2 million
Quintuplets	$m \cdot p^3 = m^4 \cdot c^3$	=	10 million
Twins, three times and triplets	$m^4 \cdot p = m^5 \cdot c$	=	13 million
Twins and twice triplets or Twins, twice and quadruplets	$m^3 \cdot p^2 = m^5 \cdot c^2$	=	51 million
Twins and quintuplets or Triplets and quadruplets	$m^2 \cdot p^3 = m^5 \cdot c^3$	=	205 million
Sextuplets	$m \cdot p^4 = m^5 \cdot c^4$	=	820 million

as frequent as women who have three sets of twins. As this proportion depends on the values m and c, it may not always be 5 : 1; it may be 6 : 1 or 4 : 1. With a change in the values m and c, the order in the table will be altered to a small degree only. Thus mothers of quadruplets, shown in the table to be as frequent as 1 : 128,000 may not necessarily be more frequent than mothers of four pairs of twins, shown in the table as

occurring only once in 160,000 mothers (past the age of reproduction). These combinations may reverse their position. This would happen if $m \cdot c$ is below 100, as it usually is, but c is equal to or larger than five. However, generally speaking the order shown in the table is stable.

For testing of values of the lower part of the table, statistics of continents and even of the whole globe, and conducted for many generations, would be necessary.

In the medical literature of the eighteenth century the opinion was expressed that quintuplets are the largest litter size in man (see Newman). During the last one and a half centuries, according to H. H. Newman ('23, '40), at least four and perhaps two more sets of sextuplets were born. Thus the former opinion had to be revised. The probability that a second revision will have to be made, inasmuch as a woman could give birth to septuplets $(= m \cdot p^5 = m^6\ c^5)$ is so small that it can be ignored.

SUMMARY

1. A new rule, amplifying that of Hellin-Zeleny, is proposed for predicting the occurrence of multiple births, from twins to sextuplets. This rule is expressed in the geometrical series m, mp, mp^2, mp^3, mp^4, where m is the number of fertile women (past the age of reproduction) of whom one has borne twins, and p is the product of m and c, the latter standing for the average number of children per mother.

2. Multiplying each term of the series by c, we derive Hellin-Zeleny's rule with an n slightly modified to our value p. If p exceeds n by no more than 4%, the discrepancies between expectation and actual number of triplets and quadruplets in the U.S. birth statistics for 1939–1940 entirely disappear.

3. Multiplying any term of the series by itself gives the expected incidence of mothers with repeated multiple births of the same litter size.

4. Multiplying any two or three terms of the series with one another gives the expected frequency of mothers with a combination of the respective multiple births of different litter size.

5. Usually one in 20 to 25 fertile women has been the mother of twins, the extreme values being 14 to 33 women. The variations of m are accounted for by factors of race, geography, physical fitness, by fluctuations of reproductive activity and of the age distribution of pregnant women.

6. A table is presented showing the order and frequency of multiple births and their combinations as predicted by the new rule. With changes in m and c only slight alterations in the order are possible.

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CONGENITAL ANOMALIES DUE TO MEASLES.— Available data would suggest that 100% of the mothers who contract rubella in the first 2 months, and approximately 50% of those who contract it during the third month, will give birth to infants with congenital anomalies.

The commonest lesions in the infants are cataracts, cardiac septal defects and patent ductus arteriosus, deafmutism and microcephaly.

Nearly all of the infants are poorly developed and are feeding problems. — C. H. Albaugh. Congenital anomalies following maternal rubella in early weeks of pregnancy. J. Am. Med. Assn., vol. 129, no. 11, 1945, pp. 719–723.

EARLY TEACHER OF PHYSICAL ANTHROPOLOGY.— There resided then [about 1775] at Göttingen professor Chr. W. Büttner, an extraordinary man, of singularly extensive learning. He had at one time been famous for the great number of languages he was skilled in, but had for many years given up delivering lectures, and was then quite unknown to the students. Just, however, about the time I came, the eldest son of his friend and great admirer, our orientalist, Michaelis, had then begun to study medicine; and his father had enjoined him to do his best and get Büttner to deliver a lecture upon natural history, which in old days he could do very well, and for which he had a celebrated collection. Immediately on my arrival I also was invited to the course, and as the hour was one I had at my disposal, I put my name down, and so came to know the whimsical but remarkable Büttner. The so-called lecture became a mere conversation, where for weeks together not a word was said of natural history. Still he had appointed as a text-book the twelfth edition of the *System of Nature;* though in the whole 6 months we did not get beyond the mammalia, because of the hundred-and-one foreign matters he used to introduce.

He began with man, who had been passed over unnoticed in his readings by Walch of Jena, and illustrated the subject with a quantity of books of voyages and travels, and pictures of foreign nations, out of his extensive library. It was thus I was led to write as the dissertation for my doctorate, *On the natural variety of mankind;* and the further prosecution of this interesting subject laid the foundation of my anthropological collection, which has in process of time become everywhere quite famous for its completeness in its way. — From a biographical note written by Blumenbach and quoted by K. F. H. Marx, 1840 (Translation by Thomas Bendyshe in *The anthropological treatises of Blumenbach and Hunter,* London, 1865).

BENJAMIN APTHORP GOULD (1824–1896) was an astromomer who made one important contribution to physical anthropology. Under the auspices of the U. S. Sanitary Commission he published *Investigations in the military and anthropological statistics of American soldiers* (New York, 1869).

REVIEWS

THE PLEISTOCENE PERIOD: ITS CLIMATE, CHRONOLOGY AND FAUNAL SUCCESSIONS. By FREDERICH E. ZEUNER. Ray Society Monograph No. 130, 278 pp. of text, 76 figures, index and biblography, 1945. (Sold by Bernard Quaritch Ltd., London.)

This work has been obscurely published and unadvertised. Only considerable detective work on the part of the reviewer brought it into his hands. Happily, it may be assumed that the conclusion of hostilities will now relieve those circumstances which have throttled intellectual exchange, even with our closest ally. Zeuner's monograph deserves a place on the shelves of all students of the Pleistocene, and it is to be hoped that the war-time limitations upon paper in England were not such as greatly to restrict the number of copies available. Only lack of advertising and listing has prevented a wide circulation among scientists in the United States.

Studies bearing on the chronology of the Pleistocene carried out by Zeuner at the University of London compose the subject matter of the monograph. Archaeological time scales and the use of cultural remains for dating purposes have been deliberately avoided. Instead, Zeuner has chosen to develop the geological, paleontological and astronomical phases of Quaternary chronology by themselves rather than continually to compromise with archaeological data. He has preferred to deal with the archaeological aspects of the Pleistocene in a supplementary volume — also announced for 1945 — called Dating The Past (Methuen). The Pleistocene Period, in other words, will form the essential basis of faunal and geological fact for the conclusions arrived at in the second book.

This does not mean, however, that the present work is without significance to the student of man. It is a comprehensive, modern, and critical summary of a vast body of data which are necessary to the complete understanding of the Pleistocene history of humanity. Zeuner possesses a gift for critical condensation, and this monograph is sure to prove an invaluable handbook and source of reference on the European Pleistocene. Principles of Pleistocene stratigraphy, including soils and terraces, are compactly but adequately treated; the astronomical interpretations of Pleistocene time are dealt with, as

are fluctuations of sea level and the faunal successions. A large amount of late literature is summarized, and regions of archaeological interest such as Palestine receive attention, even to a specific treatment of the Mount Carmel fauna.

No man can today carry out such a far-flung and ambitious project without risking criticism upon particular items. Similarly, even the most intensive coverage will often fail to turn up every significant bit of literature, or to interpret it, even when found, in a manner satisfactory to all. To quibble over such minutia would be to fail signally in appreciation of the labors of one of the most productive modern authorities on the European Pleistocene. The faunal lists alone make the possession of a copy imperative, and supplemented by its companion volume, it should place within easy financial reach a thorough survey of those difficult dating methods with which the student of human evolution is inevitably forced to concern himself.

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MEET YOUR ANCESTORS; A BIOGRAPHY OF PRIMITIVE MAN. By ROY CHAPMAN ANDREWS. The Viking Press, New York, xii + 259 pp., 20 line drawings, 1945 ($3.00).

After a long career of promoting scientific work, raising money for expeditions, directing them in the field, and running our largest museum, Dr. Andrews has written a lively popular book on the subject of human palaeontology. It was not written for the professional readers of this journal. Those of us who are professionals can do one of two things: set our glasses firmly on our noses and jot down comments on what we consider to be mistakes, page by page; or relax and enjoy the book. I started out on the first tack and ended on the second.

Speaking of mistakes, on page xi the author gives the wrong date for Weidenreich's classic The Skull of Sinanthropus Pekinensis, which appeared in 1943, not 1944. On page 139 he says that more than 100 Neanderthal skulls have been discovered to date, while on page 172 he gives the same figure for Crô-Magnon specimens. Surely only the second of these is correct. On page 148 he calls the Mousterian blades the first flake implements, omitting mention of the earlier Clacktonian and Levalloisian flakes. On page 161 he states that Neanderthal man knew how to make fire, which is still problematical, although he certainly knew how to use it. On page 165 he is equally

positive that the Neanderthal population included no medicine men, another highly dubious speculation.

These errors and perhaps some others like them could have been easily caught and corrected in proof; Dr. Andrews does not pretend to be an expert. It would have been better if someone had taken care of this, but their inclusion does no great harm; whoever reads this book and really wants to know about these things will probably go on to more technical sources.

One would like to know why Dr. Andrews is so intrigued by the notion that our remote ancestors were carrion-eaters (pp. 4–5, 104–105, 138, etc.), for which there is not the least bit of evidence. Or why (p. 231) he considers that human culture retrogressed during the Mesolithic. Or why, after having written an excellent and fairly stated resume of the Piltdown question, he disposed of the entire subject of sapiens man in the Second Interglacial in a paragraph (pp. 170–171) without even naming Swanscombe. Only the trained reader would realize that by following the old pre-Swanscombe European sequence from Heidelberg to Neanderthal to Crô-Magnon and calling the last-named the first sapiens man, he has side-stepped the whole chronological problem which has puzzled human palaeontologists for decades and which Weidenreich has done so much to solve.

Dr. Andrews pays great tribute to Weidenreich, and particularly to his book, The Skull of Sinanthropus Pekinensis, which appeared while I was away at the wars. In order to understand what Dr. Andrews was doing, I read this book and it seems to me that Dr. Andrews either misunderstood or oversimplified his principal source. Weidenreich finds, by ignoring space and time, a complete sequence of evolutionary steps from Pithecanthropus to modern man. Then, considering space and time, he shows that the rate of evolutionary progress differs spatially, so that a more advanced type may be found at a given time in locus A than in locus B. This is exactly the same situation that the student of human civilization finds in his material, and which permits Australian aborigines, equipped with only chipped flint tools, to live in the time locus which is elsewhere the Age of Atomic Energy. I may be wrong, but I feel that this proposition could be handled simply enough for Dr. Andrews' public, particularly by him, since his writing is a model of clarity.

So much for the first tack. On the other side, any reader, professional or otherwise, will find much to please him. Dr. Andrews has translated the troublesome Greek and Latin names of most of the fossil apes and men in such a way that they give a vigorous picture of the creatures in question. He spends several pages explaining how fossil beds are formed. Many a student who has passed a course in

palaeontology has never been told this. He gives us the complete story of the tailed man of the Philippines, one of the bugbears of the quote-and-requote school of textbook writing. He makes us feel that the people he talks about were alive, and he admits us to their practical problems of living. It is when he gets to the anecdotal stage of telling how the various finds were made that he reaches high gear — these are things that many professionals, including the reviewer, did not have clear. The stories of the cave explorations in France are lucid and exciting, the narrative of the discovery of the loess sites in Moravia likewise.

Best of all, from my viewpoint, are his explanations of the disposition of these sites. Most of the scientific reports deal with geology, stratigraphy, and the typology of implements. The information is segmented, and very rarely does one get a clear picture of the evidence as a whole — the room in which the crime was committed, exactly as it was discovered by the detective. I have been seeking for just this kind of material in order to deduce as much as is legitimately possible about the behavior of palaeolithic men, and I am very grateful to Dr. Andrews for digging this out and stating is so clearly.

This book should appeal to the young and adventurous. It may well stimulate and inspire some to take up the study of human palaeontology, and of anthropology in general, and if it does this we may easily forget the errors and misconceptions which could be corrected in a few hours by a professionally trained editor.

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RACE AND DEMOCRATIC SOCIETY. By FRANZ BOAS. J. J. Augustin, N. Y., 219 pp., 1945 ($2.50).

To the readers of this Journal it is unnecessary to consider in detail the contents of the volume under review. It comprises twenty-three of Boas' shorter popular articles, radio addresses, public lectures, and personal correspondence, the majority of which have previously appeared in print. They are grouped into three major categories: Race; Units of Man; Democratic Society. The principle themes of these references have been elaborated and coordinated in his well-known "Mind of Primitive Man."

As might be expected in a compendium of this nature there is considerable repetition and some inconsistency, though the latter is usually temporal. Thus, on page 23 race is defined as "a group of people descended from a common ancestry and for this reason alike

in anatomical form.'' (Nation, Jan. 28, 1925). On page 10, however, we are told that in order to analyze racial elements in a population ''we must proceed statistically . . . . we must set up standards or types and then find out how many members of a population conform with each in different regions.'' (Forum, Aug., 1937).

The entire volume reflects Boas' intense hatred for racism, for oppression, for chauvinism. Each of the twenty-three references proclaims the unending plea for human worth and human dignity. Messrs. Norman and Ernst Boas and the House of Augustin have done America a service by bringing this volume to print.

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WHAT PEOPLE ARE . . . A STUDY OF NORMAL YOUNG MEN. By Clark W. Heath and collaborators. Harvard University Press, Cambridge, Mass. xvi + 141 pp., 1945 ($2.00).

YOUNG MAN, YOU ARE NORMAL. By Earnest Hooton. G. P. Putnam's Sons, New York, xii + 210 pp., 1945 ($2.50).

Some years ago, Dr. Arlie V. Bock, Oliver Professor of Hygiene in Harvard University, set up the Grant Study, at Cambridge. He chose as subjects undergraduates of Harvard, and he recruited an unusually able group of specialists to study their various physical and psychological attributes. This study differs from other similar projects chiefly in that its principal objective is an integration of the data from the various disciplines represented by the staff in an effort to obtain a better understanding of the individual as a whole, and to develop more dependable techniques for assessing his capacities and his limitations.

Dr. Heath's book is essentially a statement of the objectives of the study, the method employed in selecting the participants, and a description of the investigative procedures to which the latter were subjected. It contains also a number of appendices and tables and a brief discussion of some selected samples of the data. The book is well organized and exceptionally well written. It tells clearly what those responsible for the Grant Study hope to accomplish by it and what they are doing in an attempt to achieve their objectives. It provides an introduction to the material contained in ''Young Man, You Are Normal'' and should be read before Dr. Hooton's volume.

As Professor Hooton points out in the preface of his book, he was asked by the staff of the Grant Study to prepare a ''simple, non-

technical account of their work, comprehensible to the general reader.'' He had no part in planning the study nor did he participate in the researches described in the book. It is the reviewer's opinion that in many respects Professor Hooton did an admirable job with what is, obviously, quite inadequate material. Though there were 268 young men in the Grant Study Series, these were divided into so many sub-groups on the basis of various criteria (some of which will be discussed later in this review) that many of the categories were too small to permit statistically valid comparisons. Consequently, the author is compelled to qualify many of his analyses of the data with the statement that the differences noted between the various groups are not statistically significant because of the inadequacy of the sample. This procedure must have been as unsatisfactory to him as it is to the reader.

Considerable emphasis is placed in the study on the relationship between physique and physical fitness, health, personality, social capacity and intelligence. It is these relationships which will perhaps be most interesting to physical anthropologists. In the classification of the physique, the staff of the Grant Study apparently found Sheldon's somatotypes a bit unwieldy for their purpose and employed instead a scheme devised by Dr. Seltzer which purports to assess the ''strength or weakness of the masculine component.'' Hooton (p. 111), refers to this system as: "The complex and somewhat mysterious aggregate of anatomical and physiological characters that had been lumped together by Seltzer under the rubric, 'strength or weakness of the masculine component.' '' The characters which Seltzer employed in determining the strength of the masculine component do not seem especially mysterious but they do make one wonder if there is not a rather large subjective element in the diagnosis. So far as one can judge from the data presented by Hooton, the strength of the masculine component does not appear to be convincingly related to much of anything except the physical characters on which it itself is based.

The ''physical fitness'' of the young men in the Grant Study Series was determined by a series of tests devised in the Fatigue Laboratory at Harvard and a comparison was made of the performance of men possessing various degrees of the ''masculine component.'' Hooton summarizes the results as follows: ''Thus there remains the sole finding that men with strong masculine component are capable of training to higher pitches of physical fitness than those of weak masculine component and that the latter may with conditioning attain mediocrity, but rarely anything more.'' Inasmuch as the classification of the various degrees of the masculine component is based to a con-

siderable extent on the degree of bony and muscular development, this finding is not especially surprising.

Similar comparisons were made of the performance of the men in psychometric tests. Of these results Hooton writes: "So, the sum total of psychometric differences on the basis of variation in strength of the masculine component amounts to a certain superiority of the less masculine men in verbalistic functions and a probable inferiority in the handling of numbers. This is not much, but in consideration of the restrictions of the sample, it is something." He had previously pointed out that (p. 112) the total averages on the Alpha Verbal tests were 189.5 for the weakly masculine as compared with 181.5 for the strongly masculine. This difference he regards as statistically reliable ("It is unlikely to be due to chance"). The scores on the Alpha Number test and its component parts were for the strongly masculine 164.5 and for the weakly masculine 158.05. This difference was not "certainly reliable." In view of the small differences in performance of those two groups it would seem that the first four words of the last sentence quoted in the beginning of this paragraph cover the matter pretty well.

The psychiatrists of the Grant Study classified what they termed the "basic" personality of the young men enrolled in their study into three categories: "Well-integrated," "Incompletely integrated," and "Over-integrated." It is interesting to note that 11% of the 257 participants in the Grant Study failed to be listed in any one of these three categories. This in attributed to the fact that only "dominant" traits were listed and men failing to show them were not included in the trait count.

Dr. Seltzer found that 61.1% of the group with strong masculine component were Well-integrated, but only 51.8% of the 27 individuals who showed weakness in the masculine component were similarly classified. In the classification of "Less well-integrated" are 13.7% of the strongly masculine and 25.9% of the weakly masculine group. The data as given are not too clear; but, if the reviewer's interpretation of them is correct, several comments seem justified.

Those with a strong masculine component made up approximately 90% of the total number, i.e., 231 of the 258 young men enrolled in the Grant Study. We are comparing therefore, 231 boys who have a strong masculine component with only 27 boys with a weak masculine component. The difference in the size of the two groups suggests a need for caution in emphasizing the apparently higher incidence of well-integrated individuals among those with strong masculine component. A further examination of these figures is instructive. If one combines the value for the Well-integrated and the Less well-

integrated, it is found that the boys with a weak masculine component come out somewhat ahead. Thus, 77.7% of them are either Well-integrated or Less well-integrated as compared with 74.7% of those with a strong masculine component. Even more interesting is the fact that 25.3% of the strongly masculine are listed as "Over-integrated" (the least desirable category) as compared with 22.3% of those with the weak masculine component. Viewed in this way, Hooton's statement (p. 93) that men of strong masculine component are somewhat more likely to be well-integrated than men with weakness in that attribute and vice-versa, while technically true, gives a somewhat distorted idea of the relationship between these two characters.

The psychiatrists of the Grant Study set up still another category of personality traits, which they termed "affect." "This term," writes Hooton, "apparently signifies the outward appearance or impression created by the mental disposition of the subject — how the personality of the individual 'affects' others. The sub-categories are: 'vital,' 'bland,' sensitive.' "

It was found that 20% of the Grant Study participants fell into the "vital" affect group, 18% in the "bland" affect group, and 17% in the "sensitive" affect group. Hooton concludes (p. 94) that the strong masculine component appears to be "strongly associated" with "vital affect," weak masculine component with "sensitive affect" and that "bland affect" is associated with neither one nor the other degree of development of the masculine component. If one considers, however, that, though 90% of the young men enrolled in the Grant Study were classified by Seltzer as having a strong masculine component, only 20% of the entire group were placed by the psychiatrists in the "vital affect" group, it becomes evident that the relationship between these two attributes is not nearly so close as Hooton's conclusion would seem to imply.

Only 55% of the Grant Study participants were classified on the basis of "affect." If, as Hooton suggests, (p. 44) the remaining 45% did not sufficiently "affect" the interviewing psychiatrist so that they were able to classify them on this basis, one wonders how valid or useful the concept really is. In the reviewer's opinion, the findings cited here fail to demonstrate the validity of either the psychiatrists' concept of "affect" or of Seltzer's idea of the masculine component.

It is regrettable that the publication of this Grant Study report was not postponed until more data had been collected and the staff had had ample time in which to ponder and digest it. Many of the findings reported in this volume are of the sort which gives real promise of providing the staff of the Grant Study with the information which they set out to get. In their present form, however, those

findings give a wholly inadequate idea of the real importance of the investigation and of what it might be expected eventually to achieve.

In the reviewer's opinion, there has been too much effort made to make the data fit into a rigid conceptual framework. This seems to have occurred despite the fact that those who planned the study intended "that the work should be as free as possible from preconception which might tend to restrict, channelize or over-specialize the procedure" (Heath, p. 104). It seems, too, that Professor Hooton has permitted his conviction that "the most obvious and practicable approach to the analyses of total man is through his physique" (p. 183) to lead him to draw from the data some conclusions in which many competent workers will not concur.

In the final paragraph of his preface, Hooton compares his role as interpreter of the Grant Study data to that of the old man in Aesop's fable who tried every possible method of getting himself, his son, and his ass to town and of satisfying the criticism of the bystanders at the same time. The reader will recall that the old man ended up by carrying the ass on his back until the animal kicked himself loose and fell into a river, while they were crossing a bridge. "By trying to please everybody, he succeeded in pleasing nobody and lost his ass in the bargain." Professor Hooton should now feel a special sympathy for the old man's misfortune; for, in his enthusiastic defense of a thesis in which he so sincerely believes, he, himself, has come perilously close to suffering a similar, and even more personal, bereavement.

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PEDIATRIC X-RAY DIAGNOSIS. By JOHN CAFFEY, The Year Book Publishers, Inc., Chicago, Illinois, xxii + 838 pp. of text, 711 figures, 1945 ($12.50).

It is timely that this comprehensive account of the roentgenographic history of man from birth to puberty, both normal and morbid, should appear on the fiftieth anniversary of the discovery of the x-ray by Roentgen. Although the title of this book might convey the impression that it is exclusively a review of clinical pediatric roentgenology, this is not so. Of value to the physical anthropologist are the succint descriptions and the numerous well-selected illustrations of normal and variational pediatric roentgenographic anatomy. Exclusive of the short accounts of the normal anatomy and development of the individual bones of the skull, 31 pages are devoted to the

normal skull and 119 pages to clinical aspects of the head. Similar accounts of other regions and structures of the body follow the same pattern.

The purpose of the book as stated by the author is two-fold: description of shadows cast by normal and morbid tissues, and clinical appraisal of roentgen findings on pediatric diagnosis. Without doubt the author has accomplished his purpose. The book is arranged in six sections: I. The Head and Neck, II. The Thorax, III. The Abdomen and Gastro-Intestinal Tract, IV. The Pelvis and Genito-Urinary Tract, V. The Extremities, and VI. The Vertebral Column. Each of these sections is divided into many subsections each of which is concerned with various aspects of the anatomical, physiological, pathological and medical backgrounds to the interpretation of the roentgenograms.

Short bibliographies of recent references follow many of these subsections. However due to the broad scope of the book, exhaustive and comprehensive bibliographies on specific topics are omitted. The extensive systematic catagorizing of topics make it easy to obtain pertinent information quickly.

This book, written by a leader in his field, is a valuable addition to the roentgenographic literature. This is especially so for, although several German texts on this subject are available, Pediatric X-ray Diagnosis is the first book on roentgen pediatrics to be published in English since Rotch's The Roentgen Rays in Pediatrics (1910). It is said with assurance that anyone who desires to obtain a well-balanced account of this period of man's ontogeny from the roentgenographic viewpoint is in for a treat when he reads this book.

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BIOENERGETICS AND GROWTH. By SAMUEL BRODY. Reinhold Publishing Corp., New York, xii + 1023 pp., 1945 ($8.50).

Anthropologists will be interested in this book because of its bearing on the basic problems of human biology in general and the phenomenon of growth in particular.

Growth is treated intensively in four chapters, entitled: Time relations of growth of individuals and populations; Linear growth, form, and function; Aging in relation to growth and efficiency; and Physiologic time and equivalence of age. These chapters comprise one-fourth of the book; the quantitative data presented in them are easily studied in a prodigious number of graphs, grouped in over 200 figures, of which almost a third are devoted in whole or in part to man. Extensive

bibliographic references are conveniently arranged in foot notes. It is possible to prefer a mathematical treatment of growth differing from that which Dr. Brody favors and still recognize the general adequacy of his method for the comparisons which he institutes.

The study of energy changes in man and domesticated animals is reviewed in considerable detail, with emphasis on the correlation of metabolism with bodily conformation, work and growth. The detailed research which has been accomplished on the energy cost of production of animal food products is capable of application to modern and primitive society. It is of some importance in the economics of nutrition that "women, in the same weight class with goats, produce milk at the same level and at the same gross efficiency as goats." Of more basic significance is the reminder that man, being an organism, is a "thermodynamically unstable and statistically improbable complexly living growing, evolving configuration."

Homeostasis is emphasized not only in a special chapter but recurrently throughout the book. The principle of homeostasis "is an extremely useful one in biology; like the theory of evolution, it binds scattered facts, apparently unrelated and confusing, into a sane whole." It emerges again in the consideration of aging. "Indeed, decline in the reserve power, or in the safety factors, required to withstand the stresses and strains of life is the best index of the aging process." An attempt is made to extend the concept of homeostasis from the regulation of the individual organism to that of human society, with war, religion and reproduction qualifying as homeostatic mechanisms.

Dr. Brody deserves commendation for the unsparing effort with which he has amalgamated the results of his own researches and those of his colleagues at the University of Missouri with facts gleaned from a myriad of other sources. This book is a storehouse not only of established fact but also of controversial conclusions and suggestions which cannot fail to stimulate future investigation.

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THE ADENA PEOPLE. By Wm. S. Webb and Charles E. Snow. Repts. Anthrop. and Archaeol. Univ. Kentucky, vol. 6, 369 pp., 1945 ($3.00).

A section on the skeletal remains by a physical anthropologist has become a regular feature of the reports prepared by and under the

direction of Prof. Webb of the University of Kentucky. During the last 10 years the following physical anthropologists have served under him: Funkhouser, Hertzberg, Skarland, Newman and Snow. This association proves that archaeologists and physical anthropologists can work together, both in the field and in the laboratory, to their mutual profit.

The present report is not just an ordinary analysis of a site; it is a summary of some dozen site reports relating to this one prehistoric population. By this arrangement the authors have avoided the repetition of details and are free to integrate the information already made available. Almost as unusual is the blending of conclusions derived from the cultural and physical remains of this population.

Over 60 pages, including about 25 figures and 8 tables, are devoted to the summary of the 265 burials. In this section Snow brings out clearly such interesting facts as the following: 54% of the burials are of young adults (25.6% indeterminate as to age); 55.5% are of males (18.1% indeterminate as to sex); approximately 92% of the restorable skulls show vertico-occipital flattening; nearly one-third of these skulls show flattened areas also on each side of the forehead just above the frontal bosses (bifrontal flattening); the 16 skulls judged to be undeformed or but slightly deformed are brachycranic; only two individuals have ear exostoses; and among the skeletons there are at least 12 (7%) with lesions probably caused by syphilis.

Snow also makes comparisons with skulls from the related Hopewell and Copena (Southern Hopewell) cultures (A separate report on the Hopewell skulls is in preparation). Here he shows that the Hopewell skulls are predominantly long-headed, although the Adena deformity customs are encountered among them to some extent. The Copena skulls, on the other hand, seem to be round-headed and in addition are deformed in the parallelo-fronto-occipital fashion.

From a consideration of all the evidence the authors are led to believe that the Adena people were the first brachycephals to reach Kentucky and that they brought with them many cultural elements new to this region. Along the Ohio river the Adena people seem to have encountered a long-headed population that earlier may have been the carriers of the Arachaic culture. (see review of Ritchie's work in this Journal). This population, it is the author's belief, took over some of the Adena culture traits and possibly interbred with the Adena people. The resulting amalgamation is Hopewell.

It is tempting to fit into this interpretation the information on syphilis; namely, that this disease was present in Adena and later periods but absent in the Archaic. Did the Adena people, who are believed to have come from the South, introduce the disease into the Ohio Valley?

An incidental point of interest to physical anthropologists is attributed to Dr. Krogman. He seems to have been able to distinguish in the cremations bones that had been burned in the flesh from bones burned in the de-fleshed, dried state (pp. 187–189). "Basically, it appears that when bones in a dry condition are incinerated, besides being calcined, they show cracking or 'checking' . . . . 'like the patina of age in an oil painting.' However, if a body should be burned in the flesh, besides possibly showing an incomplete incineration of bone, it is often possible to see under a low power magnification the remains of incompletely consumed endosteum." Why these two conditions might not also represent different stages of firing from the same beginning state is not explained.

T. D. STEWART

AN EARLY SITE IN CAYUGA COUNTY, NEW YORK. By WILLIAM A. RITCHIE. Res. and Trans. N. Y. State Archaeol. Assn., vol. 10, no. 1, x + 158 pp., map, 1945 ($1.50).

Seldom do archeologists analyze the human skeletal remains they uncover. However, Dr. William A. Ritchie of the Rochester Museum of Arts and Sciences long has been an exception to this rule. Whenever he has recovered skeletal remains he has included in his reports at least the main cranial measurements, with photographs, and often notations on pathology. These records have been very useful to physical anthropologists interested in connecting physical type with culture.

The latest addition to Ritchie's series of reports on the archeology of the State of New York has offered him an unusual opportunity to study skeletal material in a complex cultural setting. His excavations on Frontenac Island in Cayuga Lake during 1939–40 exposed 157 burials. Considering that the island has less than an acre of surface (only a part of which was excavated) and that the limestone bedrock is covered by mostly less than 29 inches of soil, the density of the burials may be appreciated. Each one was carefully worked out and many are illustrated in the 58 plates of excellent photographs included in the report.

Except for a few surface indications of late Iroquoian occupation, most of the cultural material is identical with that previously described from the Brewerton and Lamoka sites, which represent two discrete "Archaic" cultures of the New York area. Also, most of the burials were either extended or flexed. Thus one of the problems was to seek correlations between burial custom and grave goods.

The problem of more interest to physical anthropologists was the relationship between physical type and culture. Ritchie seems to

have assumed that he was dealing with a heterogeneous population, for he arbitrarily separated the skulls into three groups: dolichocranial, mesocranial and brachycranial. Furthermore, he had Georg Neumann separate the skulls by inspection and thus arrived at another division, which in effect split the mesocranial group. According to Neumann, the long-headed element corresponds to the Shell Mound type of the Southeast, whereas the round-headed element approaches the Madisonville type. This type analysis lends support to the assumption of heterogeneity. As a further check on this assumption the reviewer has calculated the standard deviation for the cranial indices of the 29 males. This measure of variability amounts to 4.04 and is much higher than the mean sigma for North American Indians (3.12).

Using Neumann's types, Ritchie shows that in a large majority of cases the flexed mode of burial was associated with the long-headed type of crania and grave goods characteristic of the Lamoka site, whereas the extended burials were prevailingly accompanied by the round-headed type of crania and grave goods characteristic of the Brewerton site. This effective use of the methodology of physical anthropology by an archeologist is one solution of the problem of how to treat human skeletal remains encountered in archeological excavations. Too often such material, with the important information it contains, goes undescribed simply for lack of interest on the part of archeologists.

T. D. STEWART

GUIDE TO LATIN AMERICAN PERIODICALS.— A most useful bibliographic aid has recently appeared under the title *Latin American periodicals currently received in the Library of Congress and in the library of the Department of Agriculture* (Latin American Series no. 8, Charmion Shelby editor, Government Printing Office, Washington, 1944, 45 cents). Publications most likely to include anthropological articles are brought together in a subject index. This is a step in the direction of the compilation of a union list of Latin American periodicals received by government agencies in Washington.

NOTES

JOURNAL ADDS A NEW FEATURE

Change in the format of journals seems to be the order of the day. Witness, for example, Science, The American Naturalist, and American Antiquity. In a smaller way this Journal, too, is changing. Beginning with this issue an effort is being made to fill the spaces that heretofore have been left blank. These wasted spaces have amounted to 15–20 pages in the course of a volume and are the result mainly of starting each article on a right hand page. To utilize these spaces there is available a great array of interesting items, both current and historical. The present sample, hastily assembled, suggests the possibilities along this line. Readers are urged to send in contributions.

In order to identify filler and set it off from the regular text a little ornament has been inserted. Since this ornament represents the comparative body proportions of man and the anthropoids it is appropriate to physical anthropology. The credit line might run something like this: Somewhat modified after A. H. Schultz, Anthrop. Anz., Jahrg. 10, Heft ⅔, 1933, taf. 1.

ILLUSTRATIONS OF THE TESHIK-TASH SKULL

During his visit to Moscow at the time of the Jubilee Session of the 220th Anniversary of the Academy of Sciences of the U.S.S.R., June 15–July 14, 1945, Dr. Henry Field obtained the photographs here reproduced of the skull and reconstruction of the Uzbekistan child. These views supplement the ones already reproduced in this Journal (n.s. vol. 3, p. 163). Dr. Field also learned that a monograph describing the skull and the associated instruments and fauna is now in the Moscow University Press and should be available during the Spring of 1946. The text is by V. V. Bunak and A. P. Okladnikov.

Fig. 1 The skull of the Uzbekistan child in two views (norma lateralis sinistra; norma verticalis). For additional views of this skull see this Journal, n.s. vol. 3, p. 163.

Fig. 2 Two views of a reconstruction of the Uzbekistan child by M. Gerasimov, sculptor-archeologist. These photographs were given to Dr. Henry Field by the Director of the Anthropological Museum of the University of Moscow.

ANTHROPOMETRIC STUDY ON THE BAPENDE AND BASUKU OF THE BELGIAN CONGO [1]

FERNAND VAN DE GINSTE
Feshi, Kwango District, Belgian Congo

EIGHT FIGURES

Central Africa, including the Belgian Congo, is still unknown as far as the anthropometric study of its diverse racial groups is concerned. As Marcellin Boule ('23) has said "there still remain many white spots on the black continent and notably in the interior." The only study made in this area on a large number of subjects is that of Schebesta ('38) who studied the morphology of the Ituri pigmies.

The present investigation on the Bapende and Basuku of the Kwango district, which was carried out in 1941 and 1943, is another contribution to the solution of the problem of the physical types of Central Africa. Other groups in this district include the Bayaka, Bayenzi, Bambala, Bahungana, Bachoka, Baholo, Bambunda, Balunda and Baminungu.

HABITAT OF THE BAPENDE AND BASUKU

The Bapende occupy a part of the Kwango district, province of Leopoldville. The territory of the Bapende extends approximately from lat. 5°30′ to 6°10′ S., and from long. 18°50′ to 20°10′ E. (fig. 1). Their country is traversed by the following principal rivers: Luchima, Lufuku, Kwilu and Loange. In the past certain groups established themselves between the Kwenge and the Luchima, and there they crossed extensively

[1] Translated and condensed with the author's permission by the Editor and Dr. M. J. Herskovits, Department of Anthropology, Northwestern University. It has not been possible to send the final draft of this manuscript or proof to the author.

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JUNE, 1946

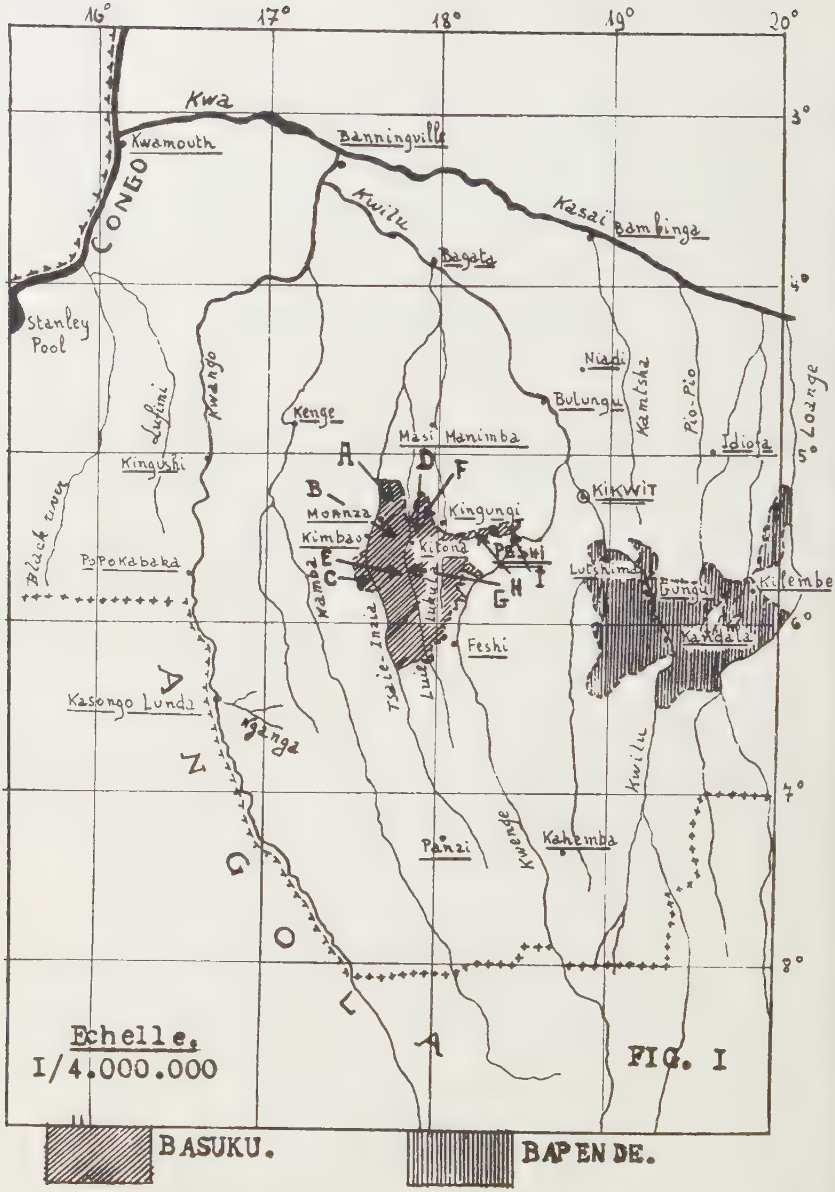

Fig. 1 Map of Kwango district, Belgian Congo, showing the habitats of the Basuku and Bapende. The capital letters A to I shown in connection with the Basuku area indicate the location of the administrative subdivisions dealt with in table 5.

with the Bambala of that region. This group, which the true Bapende call Bakwese and regard as a mixed type, does not figure in the present study. Other Bapende groups crossed the Kwilu and settled near Idiofa. Finally an important part of the Bapende resides between the Loange and the mining centers of Chikapa. We have not had the opportunity to study these groups.

The Basuku reside in the central part of the Kwango district, occupying the region in the neighborhood of Feshi. Their country extends from lat. 5°10′ to 6°10′ S. and from long. 17°35′ to 18°10′ E. This region forms a succession of arrid and desolate plains watered by the Inzia, Luie and Lukula rivers (fig. 1). The Tsay, or Inzia, is cut by the imposing Kumbila waterfall ("the thunderer"), while at Kitona, the Luie river, plunging from a height of 40 meters, forms the Lippens waterfall, discovered in 1904 by G. Logier. These falls, as will be seen in the historical section of this paper, have played their part in the migrations of the Basuku.

HISTORY OF THE BAPENDE

In 1558 the kingdom of Kongo was attacked by some Jaga peoples who captured the capital, San Salvador. The king, Alvare, took refuge on Chevaux island. From his refuge, he besought aid of the king of Portugal, Dom Sebastian, who sent out an expedition commanded by General Govéa to help him. When Govéa, after having put into port on the island of San Thomas, arrived at the Congo, his first care was to search for King Alvare, still a refugee on his island. With his force of 600 soldiers he succeeded, after a year and half of struggles, in driving out the Jaga, who in 1570 disappeared definitely from the Kingdom (Pigafetta, 1885).

A portion of the Jaga led by their chief, Imbe Kalandola, moved southward and in 1600 Battel encountered them at the Kuvu River. From here they migrated toward the Kubale River (Battel, 1625), and from there toward the region of the Bambala, 5 days' march toward the interior. In 1601, after laying waste the territory of the Bambala, they again turned

toward the north. When they reached a point near Pungo a Ndongo, capital of Angola, they turned westward. Threatened by these terrible pirates, Bandi a Ngola, king of Angola, also asked the Portuguese to intervene, and they brought the Jaga to total defeat (Cavazzi, 1687). It is important to remember, of this migration, that the people called Jaga by Battel spoke

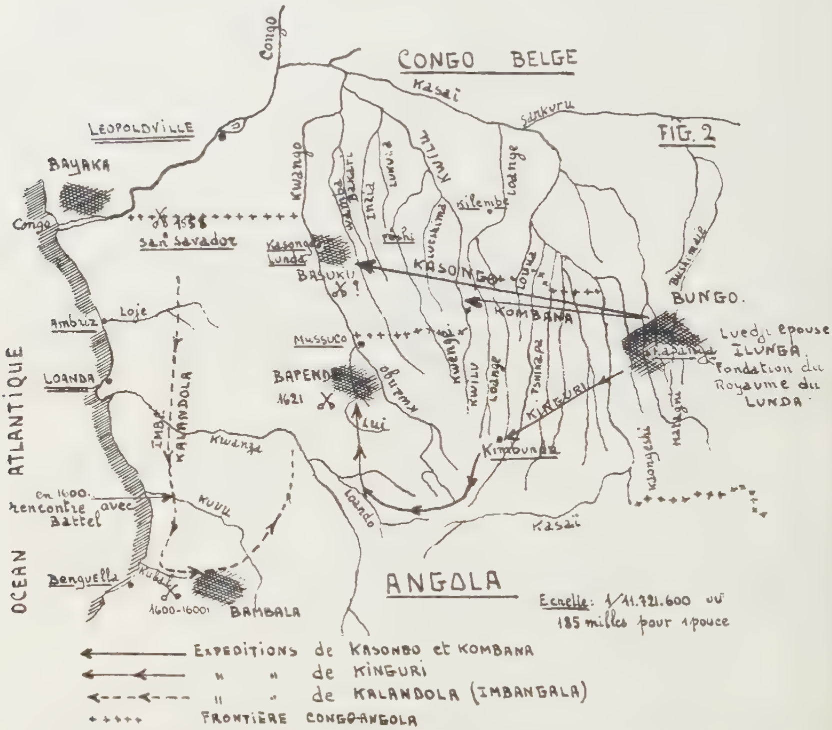

Fig. 2 Map of the Congo region, showing the early tribal movements discussed in the text.

of themselves as Bandjinji and Chimbangala, and these names are still remembered by the Bapende and Basuku.

The history of the Bapende is strongly influenced by the creation of the kingdom of Lunda in the 16th century, so the steps leading to this event must be sketched, if only in broad strokes, to afford an understanding of their past. In the 16th century the Bungo lived on the banks of the Kalanyi (fig. 2),

and Yala Maku was an important chief. By his marriage with Konti he had two sons, Kinguri and Yala, and also a daughter, born about 1590, named Lueji. These sons were bad fellows and one day they attacked their father, who was nursed by Lueji. In gratitude for her devotion, Yala Maku gave her the chiefly insignia, including the Numa bracelet and she was recognized as Mwata (chief) by the Bungo. The new state received the name of Lunda (Mulua or Runda)[2] which signifies friendship.

A Muluba hunter named Ilunga asked permission to hunt over the territory ruled by Lueji. She fell in love with him, married him, and gave him the insignia bequeathed her by Yala Maku. Ilunga thus became the first chief of the Lunda with the title of Mwata Yamvu. Subsequently the empire was extended under his successors from the Kwango to Lake Mweru.

That this tradition reflects an historical event is apparent from the number of times Avelot ('12) finds it cited by various authors [3] for different localities. Various territorial officials have reported encountering this tradition. In 1926 Requier found it among the Bayaka of the Kwango, where, however, the name Lueji was changed to Lukokisa.[4] In 1934 Frings mentioned it in connection with the Bapende of the Luchiko, though acocrding to his version Kimbinda was the husband of Lueji and Ilunga was a child of their union.[5] In 1936 Roelands came upon it among the Bajoka of the territory of Kahemba,[6] but here it has been subject to a kind of biblical reinterpretation in which Konde (another name for Yala Maku) becomes intoxicated and, when he appears before them nude, his sons

[2] Die Lunda heissen bei den Kioko "Milūa," Singular Mulūa; sie selbst aber nennen sich "Arūnd," Singular "Karūnd" oder Muku a Rūnd." (Buchner, 1883, p. 67.)

[3] These are: Pogge (1880), Carvalho (1890), Capello and Ivens (1881) and Magyar (1859).

[4] Archives ethnographiques du territoire de Feshi.

[5] Archives ethnographiques de l'ancien territoire de Kilembe.

[6] Archives ethnographiques du territoire de Kahemba.

mock him, Konde then curses his sons and transmits his authority to his daughter.

These differences in detail strengthen the historic certainty of this tradition which is carried in so many various places, because, as Pinard de la Boullaye (1925, vol. 2, p. 406) has said, "An original witness inevitably marks his testimony with a personal stamp, since he observes from the place he happens to be, sees with his eyes, and translates into his language. Where this variation is lacking, or the same details are found reproduced in the same order and in the same terms, one has a right to suspect repetition pure and simple."

The marriage of Lueji and the accession of Ilunga angered Kinguri and Yala and their partisans, and they left the country and proceeded toward the southwest. Kinguri and his band crossed the Kasai river, passed by the Kimbundu tribe, crossed the Kwango near its sources and reached the Loando river, where Kinguri married the daughter of chief Angonga and provisionally established himself between the Loando and the Kwanza. He solicited a grant of some land from the governor of Angola, Manuel Cerveira Pereira (1615–17), and was given the territory between Ambaka and Golungu, in return for which Kinguri acknowledged himself to be a vassal of the king of Portugal. Since this land was not fitted for agriculture, Kinguri and his companions went eastward. Avelot ('12), however, indicates that it was probably because he wished to get away from the governor Joâo Correa de Souza (1621–26) with whom he had quarrelled. In any event, about 1622 Kinguri arrived on the Lui (a tributary of the Kwango) where he defeated the Peindes or Bapende who lived there. This tribe, pursued by these enemies, crossed the Kwango and emigrated en masse toward the northeast. Before this exodus the Bapende were already in contact with the Imbangala (Chimbangala or Majinjis) mentioned by Battel (1625), and today they still state that the Imbangala are the ones who taught them the technique of making salt.

While Kinguri was carrying on this migration, Mwata Yamvu Ilunga sent his nephew Kasonga and his cousin

Mukelenge Mutombo toward the west for the purpose of creating there some new states to be subject to the Lunda. Kasongo pushed as far as the Kwango and succeeded in organizing the Bayaka who lived there into a powerful vassal state of the Lunda empire. Kasongo himself took the title of Kiamfu Mwene Putu Kasongo. The establishment of Kasongo certainly dates before 1663, because prior to that time, in the final years of the reign of Queen Zinga, or Anna da Souza of Matamba (1582–December 17, 1663), one of his successors suffered defeat at her hands.

In their migration toward the north a part of the Bapende turned toward the northeast and established themselves between the Lovua and the Luchiko, these being today the Bapende who live between the Loange and the Kasai rivers. A more important part turned toward the lands of the Kiamfu of the Bayaka, who attempted to bring them under his authority. In order to avoid this subjugation, the Bapende set forth again and came to a plain called Mashita banza or Mashita kizungu situated between the Luchima and the Lufuku. Here they regrouped. This country was uninhabited at the time of their arrival, and they declared themselves to be the first occupants. Shortly there broke out rivalries among the various clans over the succession of chiefs and this was the signal for a new migration. The Bapende separated and thus came to occupy the regions where today we find them, that is, distributed between the Kwenge and the Loange.

Before 1663 Mukelenge Mutombo, the companion of Kasongo, left the latter at the Lovua and turned toward the north where he encountered some groups of the Bapende which he brought under the authority of Mwata Yamvu. At this time he took the name of "Kombana." The Bapende are indebted to him for certain Lunda characteristics (Carvalho, 1890). The rest of their history until 1860 is concerned with struggles for the possession of land or over the succession of chiefs, and for this reason has only a local interest.

About 1860 the Batjok (Kioko) moved toward the north and invaded the lands of the Bapende. A confederation of Bapende-

Bakwese-Bambunda succeeded in slowly pushing them back toward the south, but only at the cost of long struggles and in 1900 the Batjok still occupied the villages situated near Kandale.

During this period, according to Capello and Ivens (1881), the Bapende maintained relations with Ambriz on the Atlantic coast. These authors under date of May 28, 1879, mention that they had just encountered the first subject (Kilolo) of the Kiamfu of Kasongo Lunda. This man told them that the Kiamfu was in direct touch with Ambriz by a route which ran along the Loje valley and that tradesmen (messengers) passed through their land in order to search for ivory and rubber in the territory of Mwata Compana and Mwene Congo Tubinge.[7] This Mwata Compana could only be the Kombana of the Bapende and this fact substantiates these relations with the Atlantic coast.

In 1889 the first Belgian expedition led by Capt. Van de Velde penetrated as far as Mwata Kombana and shortly was followed by Belgian occupation. Commandant Jean Rouling (1869–1939) of the police troop of the Kasai occupied Kandala about 1910, and State Inspector Gerard surveyed the region of Kilembe in the neighborhood of Bienge from February 22, 1913 to January 1, 1914. Lt. Heide began the occupation of Kilembe in 1914 and this became the administrative center of the territory of Haute Loange (at present territory of the Bapende). These populations did not submit to the dominion of the Congo Free State without resistance. In 1915 the Bapende between the Loange and the Kasai revolted. Their example was followed in 1916 by the Bapende living between the Kwange and the Loange, and this brought on its occupation by Lt. Colinet. These populations were eventually sub-

[7] p. 123: Primeiro quilolo do Quianvo hoje em vista. Conserva relaçoes commercias com a costa (Ambriz) por um caminho directo que prolonga o Loje (rio) por intermedio dos ma-sosso, quando em procura de borracha e marfim atravessam as suas terras para irem ate a Muata Compana e Muene Congo Tubinge. Este ultimo soba parece ser importante. Tem a sua habitação na margem do Muluia e fronteira a um grando rio, que dizem denominar-se Baccari.

dued, but agitation against the foreigners continued to be stirred up by secret societies.

In 1931 under the influence of the Jinda and Lukusu societies, the Bapende of Kandale and Kilembe suddenly revolted and on June 8 assassinated M. Balot, a government agent. This revolt spread so rapidly and was so acute that it required the intervention of large military forces, which crushed the uprising before the end of the year. However, it was followed by passive resistance indicative of latent revolt which continued until 1933 when the military occupation was definitely withdrawn.

After this sketch the Bapende history it is not difficult to disentangle the Lunda influence that chiefs like Kombana infused into Mupende society. It is for this reason that Bapende chiefs are called Mwata, essentially a Lunda name. The Mwata of the Kangu and Kombana groups declare themselves to be of Lunda origin, and Ilunga, the present chief of the Kombana group, still maintains contacts with the Mwata Yamvu of Kapanga. These contacts consist of exchanges of gifts (textiles, gunpowder) which do not constitute a tribute properly speaking, but are rather a recognition of vassalage. The bearer of these gifts, who with other dignitaries, travels the great distances between Kapanga and the territory of the Bapende, has the title of Mwlua and the basket containing the presents destined for Mwata Yamvu is called Kakala ya Mwata Yamvu. Finally, it should be noted that at the present time several secret societies exist which have the purpose of rendering worship to the spirits of the ancestors, the Mungonge, the Mungonge ya kukela for men and the Kiwila for women. When one inquires concerning their origin, the Bapende invariably reply that they were introduced among them by the Lunda chiefs.

HISTORY OF THE BASUKU

The Basuku appear in historic records in 1539 and 1583, when in a letter dated February 12, 1539, addressed to Pope

Paul III, King Alfonso of the Congo named his principal states, among which is the "Musuco" (Paiva Manso, 1877)[8].

Plancquaert ('32, p. 21) mentions another document in the Vatican archives that was sent to the Pope in 1583 by King Alvare. Here in enumerating his states Alvare speaks of the "Mosoque," which is only another spelling of the "Musuco" of the 1539 document.[9]

Nevertheless, one can raise the question if at this time the Basuku were still really part of the kingdom of the Congo, since Angola, which figured in the text of 1583 as a vassal state, was in fact made independent under the reign of the king of Angola, Ndambi a Ngola (1560–87).

These documents give us absolutely no information concerning the geographic position of the Basuku, nor does Duarte Lopez (Pigafetta, 1885) who so minutely described the kingdom of the Congo, mention them. The documents of 1539 and 1583 thus give us the only information we possess concerning the history of this people and their migrations must therefore be reconstructed by studying their historic traditions.

The Basuku tell how at the beginning of their history they lived along a river called "Pombo Kabaya," and that the Batsamba and Bangongo were their neighbors. They left this river because their neighbors made war on them, descending the Kwango to establish themselves in the region watered by the Nganga and the Pasa, tributaries from the right of the Kwango (fig. 1). The great Musuku chief, Minikongo, lived at the Nganga and his principal vassal Buka Kipangu was in-

[8] "Dom Affonso per graça de Deos Rey de comguo e Ibungu cacomguo e agoyo dequem e dalem azary Senhor dos ambundos dambolla daquisyma masuaura e de Matamba e de muyllu e de musuco e dos amzicos e da conquista de pamzo alambu."

[9] "Don Alvaro per la gratia di Dio Re di Congo, Dangoglia, di Matamba, di Quisima, di Muyglio, di Mosoaur, di Mosoque, delli Anziqui, di Sumbua, di Buanga Signor di sette regni de Congo Riamullaza, di Cacongo, di Guyo, di Rio zayre et della conquista." (Arch. Vatic. Nunz di Spagna, vol. 38, f° 243.)

stalled at the Pasa. Secondary vassals, such as Mutangu, Mobanga, Bumba and Mwela, also lived in this region.

The Balunda-Balua (successors of Kasongo, nephew of Mwata Yamvu Ilunga) established themselves near Minikongo and their Kiamfu, Kibinda, entered into cordial relations with the Minikongo of the period, Tona di Lukeni. Under terms of an amicable agreement, they divided the country into hunting territories. These good relations changed rapidly because the Basuku resented the success in the hunt of Kibinda's people. They hid well sharpened small sticks along the path used by Kibinda as he went to hunt, so that he injured his feet when he stepped on them. He asked amends of Minikonko for this injury, but only received an abrupt refusal from the Musuku chief. Kibinda continued to hunt, but with the firm intention of avenging himself. He invited Minikongo to a feast, but in the house where he was to stay he had a pit dug. This he covered with a mat, so that he would be buried alive. Kombo, a brother of Buka Kipangu, exposed the trick when he pierced the mat with his cane. Minikongo, furious that Kibinda dared make an attempt on his life, called together his men to wage war against Kibinda's people.

But the Basuku were consistently defeated, and soon Minikongo crossed the Kwango to take refuge among the Bambata and Bansombo (in the Batta province of the kingdom of San Salvador), while Buka Kipangu and his other subjects retired on the Wamba. The Basuku chiefs sent delegates to Minikongo to ask that he rejoin the mass of the people. But soon after Minikongo returned to the Wamba, the Kiamfu attacked him again and dislodged him from his position. Pursued by the warriors of the Kiamfu, the Basuku arrived at the Bakari where they vainly attempted resistance. They crossed this river and went toward the Tsay (Inzia), which they had to cross far above the Kumbila waterfall. But when they arrived at the Luie, and sustained another defeat, they had no other alternative than to cross the Lukula and to flee toward the

Kwenge where they put up a final resistance on the stream called Lubamba. This country had been inhabited by the Bahungana who retired before these invaders and took refuge on the Kwilu. Aided by the Bambala, they dug some trenches (mawulu or mosala) and each chief at the head of his men had to defend a bastion. These tactics routed the Balunda-Balua who were held before this unexpected obstacle.

The war was ended by the death of the Kiamfu who was killed by the Bambala. This event must have occurred after 1600, because at this date the band of Imbangala of which Battel was a part ravaged the province of the Bambala in Angola (see the historical section on the Bapende). The Basuku and the Balunda-Balua made peace and decided that henceforth the Tsay would form the frontier between the states of the Kiamfu and those of Minikongo, and that the latter would no more cross this natural boundary. The Basuku finally installed themselves in the Nzumbu a vunvu plain near the Lubamba, and Minikongo sent his subjects to occupy land as far as the Inzia, while he installed himself at Peshi, far from this river (fig. 1).

Certain Basuku clans remained in the region of the Nganga at the time of Minikongo's flight. They are still there, and this isolated group bears witness to this migration. Other Basuku have migrated toward the south to Angola, where we find them in the neighborhood of the Musuku mission. They are governed there by a chieftainess who bears the title Ngudi a Kama ("the mother of all," or "the mother of the chief"). This chieftainess is even more important than Minikongo and her existence was noted on August 22, 1913, by Commandant Sörensen, who made at that time a reconnaissance along the Congo-Angola frontier. The Basuku of the Nganga and of Ngudi a Kama still preserve some contacts with Minikongo, which consist of exchanging small gifts, last bonds of the vassalage which is now no more than an illusion.

Finally, Capello and Ivens (1881) cited the name of Minikongo as of May 28, 1879, under the form of Mwene Congo Tubinge. They noted that he sold ivory and rubber to markets along the Atlantic coast and that his states were separated from those of the Kiamfu by the Bakari river (see the historical section on the Bapende).

Between the time of the Belgian occupation and the present, the history of the Basuku does not include anything of importance. The Basuku having been made part of the Congo kingdom of San Salvador have undergone strong Bakongo influence. The very title of Minikongo recalls that of the king of San Salvador, or Mani Kongo, of the early authors. Their language, Kisuku, is an archaic form of Kikongo, which is the language now spoken in the Lower Congo.

SELECTION OF SAMPLE

According to recent censuses the two groups under examination consist of the following:

	BAPENDE [10]	BASUKU [11]
Men	28,455	18,139
Women	34,186	23,920
Boys	20,913	18,914
Girls	20,457	18,354
Total	104,011	79,327

From the 28,455 Bapende men, 2000 were selected at random for measurement. They were obtained in the following places: (a) in 33 villages; (b) in 3 workers' camps of the Kasai Company; (c) in the Kilembe Mission; (d) in the prison at Gungu; (e) in the prison at Kilembe. In a similar manner, 2000 men were selected from the 18,139 Basuku, who were measured in 97 villages and in the Kitona prison. Thus it is to be expected

[10] Administrative census of 1941.

[11] Medical census of 1942 taken by Foréami (Fonds Reine Elisabeth pour l'assistance médicale aux indigènes du Congo Belge). I am indebted to Dr. De Brauwere, medical director of Foréami, for permitting me to use this census.

that these series represent two good samples of the total male adult population of the two peoples studied.

MEASUREMENTS AND TECHNIQUE

The measurements taken on each individual consisted of stature, the two main diameters of the head and the length and breadth of the nose. The dimensions of the head and nose will be considered here only in the form of their respective ratios — the cephalic and nasal indices.

Stature was measured by means of a graduated wooden rod ("toise") 6.4 feet in length. In practice this rod was carefully adjusted in a vertical position and fastened against a wall. The subject was placed against the rod with eyes looking horizontally forward, heels together and feet forming an angle of 45°. Then the stature was read by means of a metal square which slides along the rod. The figure was read to the nearest millimeter to avoid confusion in forming the frequency classes. Thus statures 161.9 and 162 fall respectively into classes 160–161.9 and 162–163.9. The same precautions were taken for the cephalic and nasal indices.

The standard head and nose measurements were taken by means of large and small spreading calipers. The accuracy of these calipers was tested throughout the trip by means of a standard block ("planton"). The calculation of the indices was carried out to two decimal places and then rounded off in the following manner: 74.65 = 74.7; 74.67 = 74.7; 74.63 = 74.6. Thus, if the second decimal is below 5 the first decimal is not raised; if the second decimal is 5 or more than 5 the first is raised.

It may be of interest to add that, when this work was begun, the natives were distrustful of anyone taking measurements upon them, for the reason that this was associated in their experience with military recruiting. In order to allay their fears I avoided recording names and used merely serial numbers. The only other associated record was the name of the village. Unfortunately, this circumstance has made it impossible for me to remeasure a part of this sample for purposes of determining personal error.

TABLE 1

Frequency distributions for stature as observed and calculated.

STATURE CLASS	BAPENDE Observed frequency	BAPENDE Calculated frequency	BASUKU Observed frequency	BASUKU Calculated frequency
134–135.9	. .	. .	1	*0*
136–137.9	. .	. .	2	*1*
138–139.9	. .	. .	6	*4*
140–141.9	. .	. .	12	*10*
142–143.9	1	*0*	22	*23*
144–145.9	1	*1*	31	*44*
146–147.9	4	*3*	78	*75*
148–149.9	9	*10*	117	*116*
150–151.9	26	*22*	167	*161*
152–153.9	38	*43*	212	*203*
154–155.9	66	*75*	226	*232*
156–157.9	120	*116*	230	*243*
158–159.9	175	*161*	241	*231*
160–161.9	204	*203*	195	*201*
162–163.9	214	*231*	157	*160*
164–165.9	250	*239*	122	*117*
166–167.9	217	*227*	81	*79*
168–169.9	203	*198*	48	*48*
170–171.9	153	*159*	32	*27*
172–173.9	132	*118*	7	*14*
174–175.9	82	*81*	7	*7*
176–177.9	49	*51*	3	*3*
178–179.9	23	*30*	1	*1*
180–181.9	10	*17*	1	*0*
182–183.9	15	*8*	1	*0*
184–185.9	4	*4*		. .
186–187.9	2	*2*		.
188–189.9	1	*1*		.
190–191.9	1	*0*		

STATURE

The frequency distributions for stature, both as observed and as calculated [12] are shown in table 1. The mean for the

[12] The theoretical distribution has been calculated with the aid of the following formula (Montessus de Ballore, '31):

$$Y_x = \frac{m!}{(mp - x)!\ (mq + x)!}\ p^{mp-x}\ q^{mq+x}$$

This formula summarizes the problem of a container filled with red and black balls in the proportions p and q and where Y_x is the probability of extracting $mp - x$ red balls and $mq + x$ black balls, m being the number of drawings and mp a whole number.

The values of p and q for each of the present samples are as follows: (p. 140)

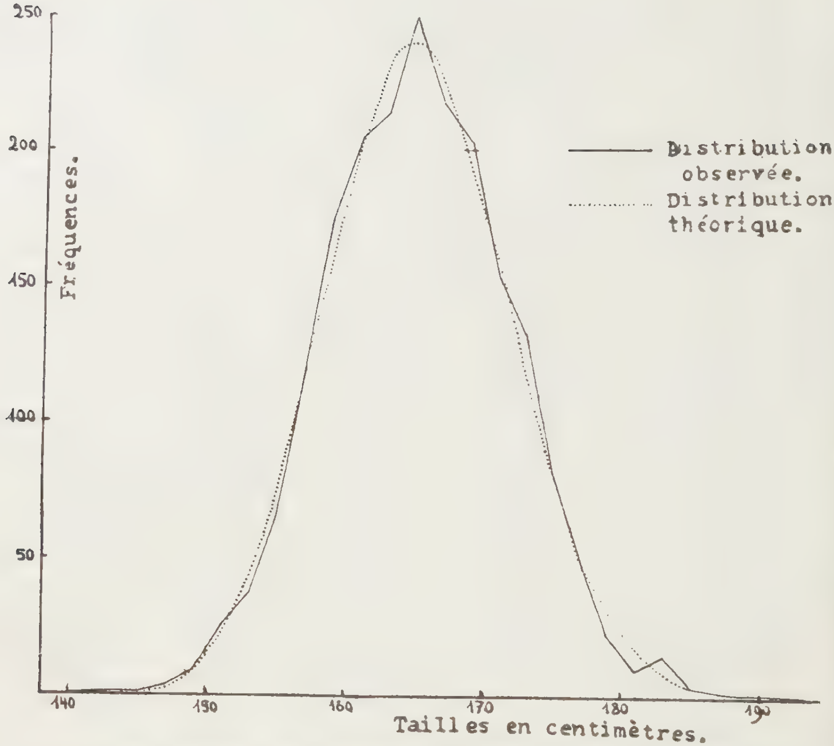

Fig. 3 Graph showing the distribution of stature, both as observed and as calculated, for 2000 Bapende adult males.

Bapende is 165.3 ± 0.09 cm (σ 5.96) and for the Basuku 157.2 ± 0.09 cm (σ 5.68). The difference amounts to 8.1 cm in favor of the Bapende and is statistically significant (x p.e. = 62.3). The Bapende thus are near the world mean fixed at 165 cm by Topinard (1885), whereas the Basuku fall into the small stature group (Haddon, '25).

[12] (Continued).

	BAPENDE			BASUKU		
	Stature	Cephalic index	Nasal index	Stature	Cephalic index	Nasal index
p	0.72521	0.81778	0.63494	0.61966	0.622556	0.934133
q	0.27479	0.18222	0.36506	0.38034	0.377444	0.065867
$p + q$	1.00000	1.00000	1.00000	1.00000	1.000000	1.000000

Inspection of the theoretical and actual distribution curves given in figures 3 and 4 shows close agreement. This is borne out by the chi square test of Pearson ('14), for P = 0.502 in the case of the Bapende and 0.506 in the case of the Basuku.

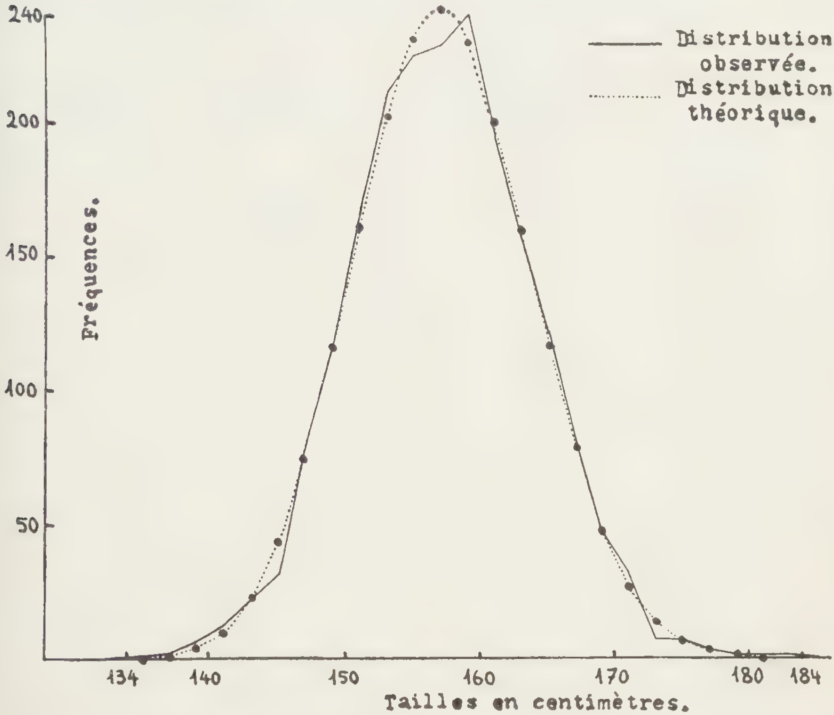

Fig. 4 Graph showing the distribution of stature, both as observed and as calculated, for 2000 Basuku adult males.

CEPHALIC INDEX

The frequency distributions of the cephalic index are listed in table 2 and shown in the form of curves in figures 5 and 6. For the Bapende the mean is 74.2 ± 0.05 (σ 3.05); for the Basuku 74.6 ± 0.05 (σ 3.11). Although the difference in favor of the Basuku is only 0.4 it is statistically significant (x p.e. = 5.7). According to Deniker ('26), these mean indices represent very narrow heads that are classed as hyperdolichocephalic.

As in the case of stature, agreement is good between the theoretical and actual distribution curves. By the chi square test, P = 0.842 for the Bapende and 0.957 for the Basuku.

TABLE 2

Frequency distributions of cephalic index, both as observed and calculated.

INDEX CLASS	BAPENDE		BASUKU	
	Observed frequency	Calculated frequency	Observed frequency	Calculated frequency
64–64.9	1	*0*	..	.
65–65.9	2	*2*	2	*3*
66–66.9	9	*7*	5	*7*
67–67.9	21	*19*	22	*17*
68–68.9	40	*43*	38	*36*
69–69.9	67	*81*	61	*67*
70–70.9	135	*133*	118	*110*
71–71.9	201	*188*	170	*161*
72–72.9	220	*234*	197	*209*
73–73.9	265	*258*	244	*243*
74–74.9	258	*257*	243	*256*
75–75.9	245	*229*	244	*243*
76–76.9	171	*187*	223	*209*
77–77.9	152	*139*	156	*163*
78–78.9	84	*95*	120	*116*
79–79.9	61	*60*	66	*74*
80–80.9	34	*34*	46	*44*
81–81.9	16	*18*	25	*23*
82–82.9	10	*9*	10	*11*
83–83.9	2	*4*	8	*5*
84–84.9	5	*2*	1	*2*
85–85.9	0	*1*	1	*1*
86–86.9	1	*0*	..	

NASAL INDEX

Table 3 shows the observed and calculated frequency distributions for this index. The Bapende mean is 100.8 ± 0.17 (σ 11.19); the Basuku mean is 103.4 ± 0.13 (σ 8.76). The difference of 2.6 in favor of the Basuku is significant (x p.e. = 12.3). These high mean nasal indices represent very broad or hyperplatyrrhine noses.

Unlike other curves, those for the nasal index (figs. 7 and 8) show rather poor agreement and this is confirmed by the

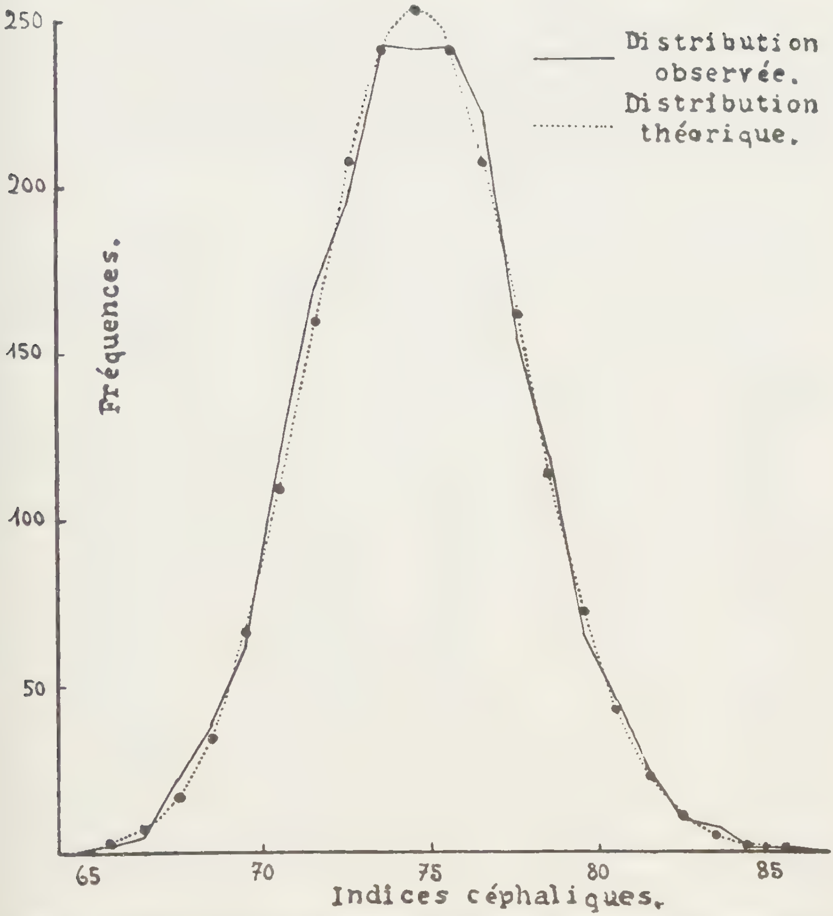

Fig. 5 Graph showing the distribution of cephalic index, both as observed and as calculated, for 2000 Bapende adult males.

chi square test (P in the case of the Basuku is 0.000221). Probably this reflects a considerable error in the technique of measuring the nose. It is especially difficult to locate nasion in the Negro because the angle that the nose makes with the forehead is very broad.

THE BASUKU CHIEFS

Among the Bayaka, who are the western neighbors of the Basuku and whose habitat extends from the Inzia to the

Kwango, there is a directing class of Lunda origin which dominates the true Bayaka, who are of Yaga stock. The Basuku declare themselves to be of Bayaka origin, and the question could be raised if the Basuku chiefs are descended

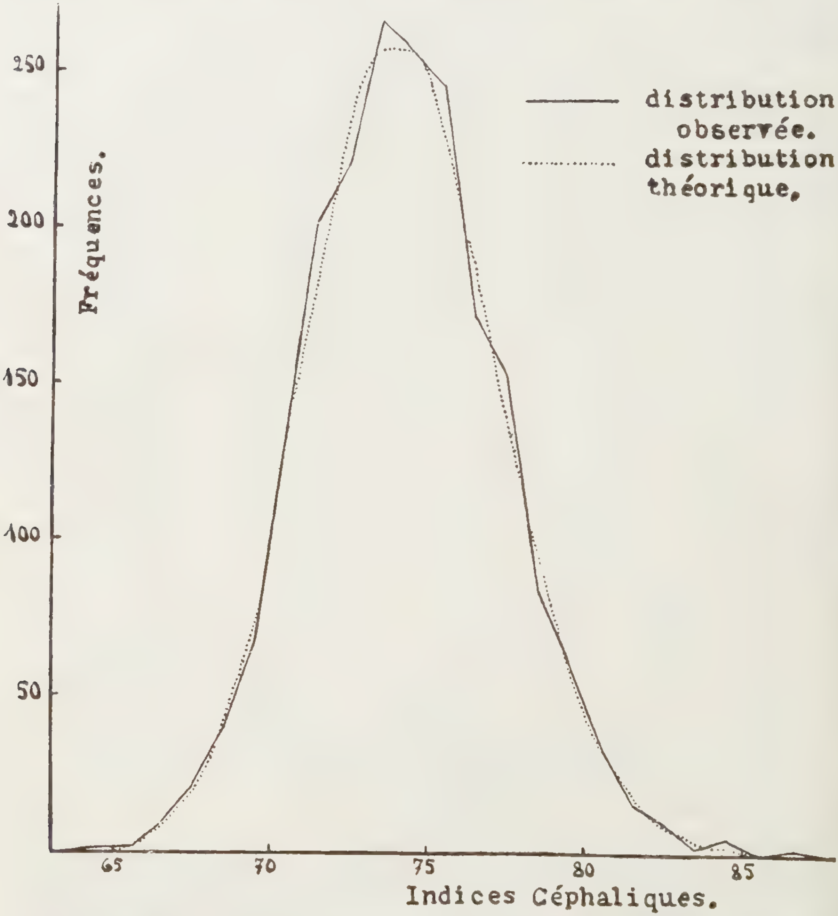

Fig. 6 Graph showing the distribution of cephalic index, both as observed and as calculated, for 2000 Basuku adult males.

from the Basuku population, or whether they are the product of a different group. The present sample of 2000 adults includes 38 chiefs and other prominent Basuku. The frequencies of observed stature, cephalic and nasal index in this small

TABLE 3

Frequency distribution of nasal index, as observed and calculated.

INDEX CLASS	BAPENDE Observed frequency	BAPENDE Calculated frequency	BASUKU Observed frequency	BASUKU Calculated frequency
64– 66.9	1	*1*		
67– 69.9	1	*3*		
70– 72.9	5	*7*		
73– 75.9	8	*14*		..
76– 78.9	29	*26*	4	*2*
79– 81.9	42	*45*	13	*9*
82– 84.9	70	*69*	12	*23*
85– 87.9	95	*100*	43	*51*
88– 90.9	162	*133*	107	*93*
91– 93.9	154	*166*	146	*145*
94– 96.9	149	*191*	184	*196*
97– 99.9	179	*207*	198	*235*
100–102.9	308	*208*	271	*252*
103–105.9	174	*197*	294	*245*
106–108.9	163	*174*	223	*216*
109–111.9	159	*144*	165	*175*
112–114.9	107	*113*	143	*131*
115–117.9	66	*77*	72	*91*
118–120.9	44	*53*	56	*59*
121–123.9	38	*34*	30	*36*
124–126.9	20	*19*	14	*20*
127–129.9	12	*10*	7	*11*
130–132.9	6	*5*	7	*5*
133–135.9	7	*3*	8	*3*
136–138.9	1	*1*	2	*1*
139–141.9		..	1	*1*

group are shown in table 4. The means of this series and of the remaining Basuku compare as follows:

	38 CHIEFS, ETC.	1962 COMMONERS	DIFFERENCE
Stature	159.68 ± 0.65	157.12 ± 0.10	2.56 (x p.e. = 3.9)
Cephalic index	74.66 ± 0.34	74.61 ± 0.05	0.05
Nasal index	102.74 ± 1.04	103.21 ± 0.02	0.47

The mean stature of the chiefs and notables is therefore 2.56 cm above that of the commoners, whereas the cephalic index and nasal index of the two groups correspond closely. Although the series of 38 is very small in relation to the series of 1962, a difference of 2.56 is statistically significant. Since

the cephalic and nasal indices accord, it is possible that the Basuku chiefs are recruited from the body of the Basuku population, with perhaps some favoring of tall stature. On the other hand, it may be significant that the metrical differences distinguishing the chiefs from the commoners are in the direction of the Bapende.

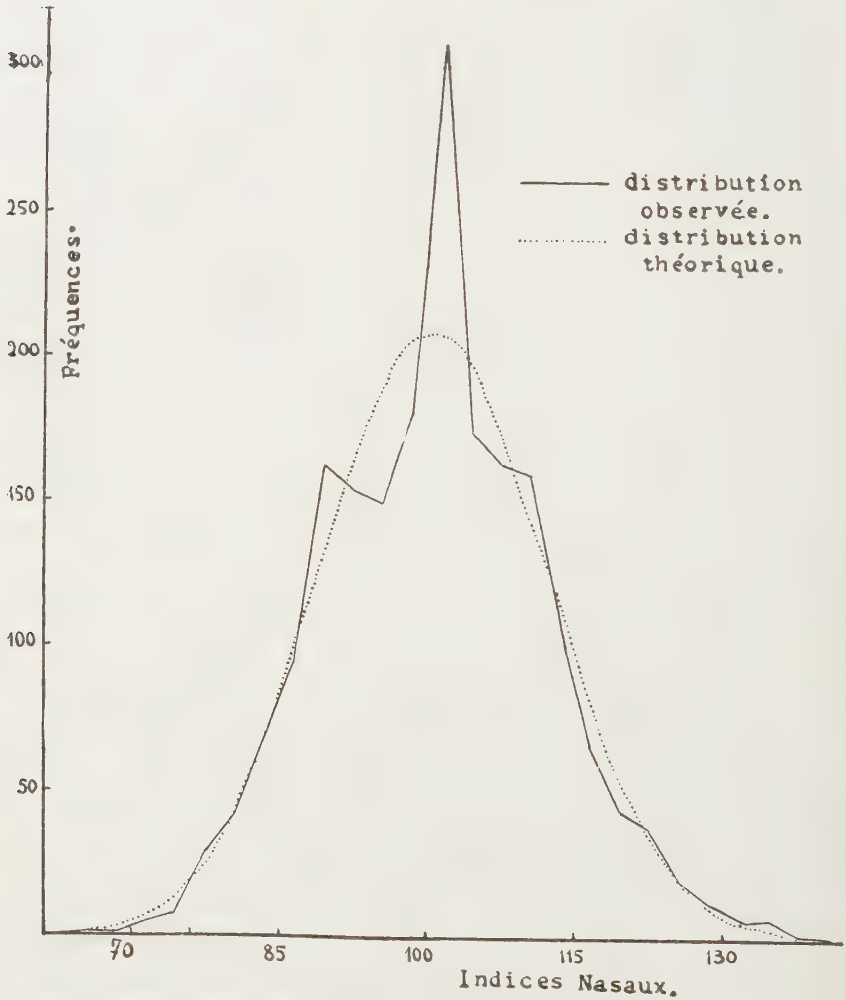

Fig. 7 Graph showing the distribution of nasal index, both as observed and as calculated, for 2000 Bapende adult males.

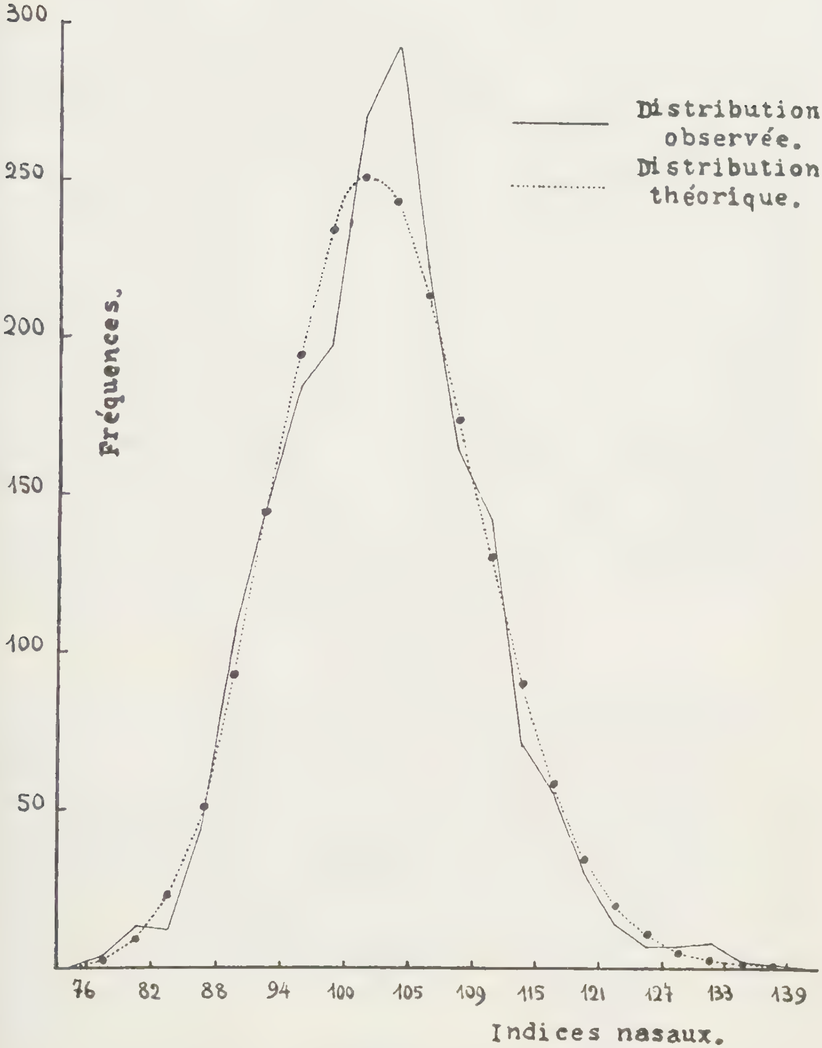

Fig. 8 Graph showing the distribution of nasal index, both as observed and as calculated, for 2000 Basuku adult males.

GEOGRAPHICAL DISTRIBUTION OF THE ANTHROPOMETRIC CHARACTERISTICS OF THE BASUKU

The territory of the Basuku, in which the 2000 adults have been measured, includes administrative subdivisions some of which are indicated by the capital letters in figure 1 and in

TABLE 4

Frequency distributions for stature, cephalic index, and nasal index of 38 chiefs and other notable personages of the Basuku.

STATURE		CEPHALIC INDEX		NASAL INDEX	
Class	Frequency	Class	Frequency	Class	Frequency
144–145.9	1	67–67.9	1	88– 90.9	5
146–147.9	..	68–68.9	..	91– 93.9	4
148–149.9	2	69–69.9	..	94– 96.9	5
150–151.9	2	70–70.9	2	97– 99.9	2
152–153.9	2	71–71.9	4	100–102.0	4
154–155.9	1	72–72.9	4	103–105.9	3
156–157.9	6	73–73.9	7	106–108.9	3
158–159.9	7	74–74.9	6	109–111.9	3
160–161.9	2	75–75.9	1	112–114.9	2
162–163.9	5	76–76.9	6	115–117.9	4
164–165.9	4	77–77.9	2	118–120.9	2
166–167.9	1	78–78.9	1	121–123.9	.
168–169.9	4	79–79.9	2	124–126.9	1
170–171.9	1	80–80.9			
		81–81.9	1		
		82–82.9	1		
Total	38		38		38

TABLE 5

Geographical distribution of three anthropometric characters of the Basuku.

REFERENCE LETTER [1]	ADMINISTRATIVE SUBDIVISION	AVERAGE STATURE	AVERAGE CEPHALIC INDEX	AVERAGE NASAL INDEX
A	Buka Kipangu	158.2	73.9	102.3
B	Ngombe	156.9	73.8	102.8
C	Kasombo	157.3	75.4	105.4
D	Buka Tsona	156.2	74.4	104.3
E	Muzengo	158.2	73.9	105.3
F	Mwela Ndua	155.7	74.6	101.6
G	Loanda-Bwangongo-Zalala	156.6	74.8	101.6
H	Menikongo	157.2	74.7	100.1
I	Kibolo	158.4	75.1	106.9
	Maximum difference	2.7	1.6	6.8

[1] See map, figure 1.

table 5. By means of these subdivisions the question whether the anthropometric characters of the Basuku are distributed uniformly in space and how greatly they vary around the general means has been investigated. As already stated, observations include the names of the villages where the measurements were taken. Consequently, the mean of the stature and cephalic and nasal indices can be found for each subdivision in table 5, where each subdivision has been represented by a capital letter which in turn may be found on the map, figure 1.

Inspection of this table shows some very small differences between the means calculated by subdivisions and the general means of the 2000 adults. From this I conclude that the anthropometric characters of the Basuku are uniformly distributed throughout the geographical area occupied by them and that it is the question of a homogeneous population dispersed over an enormous geographic surface.

COMMENT

Since so little is known anthropometrically about the native peoples of Central Africa, it is felt that it is too early to undertake general comparisons with the new data here presented. The significant point about these data is the marked difference in mean stature between the Bapende and Basuku. Also, a somewhat broader nose seems to go with the shorter stature of the Basuku. When other data of this kind are available perhaps it will be possible to see how the history of these two groups, as it has been related here, bears upon this problem.

SUMMARY

As a background for the anthropometric data, the present geographical locations and the historical movements of the Bapende and Basuku are outlined.

A sample consisting of 2000 adult males from each of these groups was measured for stature, the two main diameters of the head, and length and breadth of the nose. The dimensions

of the head and nose are considered only in the form of their indices.

It is shown that the Bapende are of medium stature (165.3 cm), whereas the Basuku are of small stature (157.2 cm). Both are hyperdolichocephalic (74.2 and 74.6, respectively), and both are hyperplatyrrhinic (100.8 and 103.4, respectively). The irregular distribution of the nasal index suggests a fault in the technique of locating nasion.

Separate analysis of the measurements of 38 chiefs and other prominent Basuku indicates that they are merely a little taller than the commoners. Subdivision of the Basuku series on a geographical basis reveals considerable uniformity in the measurements.

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EARLY DESCRIPTION OF AGE CHANGES.— A new-born child has scarcely any physiognomy, expresses no thinking, and needs nothing more than to eat and sleep. It is the embryo of the lymphatic temperament. The forehead is convex and protuberant. The face turns inward beneath faintly delineated brow ridges, due to the fact that the skull presents a great development compared with the face. The eyes are even with the head, and seem very large and quite distant from each other, though not to such an extent that it would be possible to interpose another eye between them. The eyebrows are barely defined. The nose is small, with no fixed shape, and the sulcus of the upper lip under the septum of the nares is very deep. The mouth seems tight because the teeth have not erupted. The lower part of the face has little prominence, owing to the lack of development and exercise of the jaws. The cheeks are full and fleshy, with a fine skin covered with a soft down like that of an unripe peach. Only when there has appeared the last molar tooth, called the "wisdom" tooth, is it possible to say that the face is complete and the jaws perfected. for they are no longer separated from each other, and thus the chin is extended.

With increase in age, the features become more deeply defined. There appear the physiognomy of sex, family, breed, and individual character. During puberty the bones of the cheeks and nose attain

their full development, presenting a clear-cut expression; the limbs lengthen, the chest expands, and the look gleams with fire and love. The first hairs adorning the chin of the youth have a handsome expression of force and passion, just as in the virgin the shyness which constantly ascends into her cheeks certifies to the strange lusts which stir in her bosom. . . .

After the man has reached full vigor, the complete evolution of his members, and the sublime and austere beauty of virility, his shoulders become broad, and the features angular and robustly defined. In him all is strength, equilibrium, wisdom, and resolution. . . . In the woman middle-age is presaged by the more matronly conformations which have replaced the delicate features of the virginal flower of youth, by the great development of her breasts and nipples, her large hips, her furrowed belly, etc.

Then follows the period of disagreeable old age, with its wrinkles, enfeebled limbs, duller senses, frozen feelings, and memory living only in things gone by; with love of gold and a tenacious attachment to life. The head becomes hoary, then bald. It trembles. The forehead curves, and its furrows unite near the median line. The mouth shortens from loss of teeth, wasting of the alveolar margins of the jaws, and contraction of the bony palate. The muscles of the cheeks, now relaxed and weak, cannot keep the jaws firmly closed. The chin comes near the nose, which bows and droops with its point on the mouth. The eye loses its sprightliness; its color fades and becomes light green. The skin becomes wrinkled, the legs and arms scarified, the fingers calloused and deformed, the articulations rigid, and the gait unsteady. At this age the organs have gradually changed from what they were in youth, so that the sensations they now receive are quite different from those they once were. Hence arise the erroneous notions of old people, or, at least, this is the reason why their precepts are not heeded or practiced by youth. . . .

Every function now withers. Vessels and cartilages ossify, ducts clog, muscles lose control of the limbs, orifices expand, the hearing dulls from the hardening of the membranes, the eye becomes blind from cataracts, and taste and smell torpid from the lassitude of the nerves. The lips dangle loose, and saliva falls disgustingly from the corners of the mouth and mucus from the nose. The head is bent towards the earth and breathing is labored. Thoughts barely break forth when they vanish away, and the strain of reasoning is no longer possible. In short, the organism has used up the last particle of life which animated it, and now it must dissolve away. Not for one instant do our cravings for immortality prolong the limits of this period.—Giovanni Polli. *Saggio di fisiognomonia e patognomonia*, Milano, 1837 (Translation by William A. Lessa.)

SOMATOTYPES OF AN ADOLESCENT GROUP [1]

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THREE FIGURES

INTRODUCTION

A few years ago a study of adolescents was begun at a boys' college preparatory boarding school in an attempt to determine the normal values and usual ranges of various anthropometric, physiological and psychological data, to determine the factors in social and academic success and good health in that environment, and to explore the relation between various aspects of the data. As part of that study somatotype photographs were taken according to the method described by Sheldon, and it is with that portion of our data which this report deals.

Three successive first year classes were carefully studied. The first group is composed almost exclusively of students who were either 14 or 15 years of age at the time of their admission to school; the second and third groups embraced all white members of those classes, regardless of age. The distribution of ages at the time the somatotype photographs were taken is given in table 1.

Despite the fact that little selection was involved in these groups, the present study obviously cannot be considered as one comprising a typical cross section of all adolescents. Students attending a large New England college preparatory school which stresses high standards of scholarship, resourcefulness and independence may differ from those who attend

[1] From the Department of Health, Phillips Academy, Andover, Mass., and the Grant Study, Department of Hygiene, Harvard University.

a smaller or more paternalistic one or one located elsewhere, but no doubt this selection factor operates more strikingly when one considers those who graduate rather than those who are accepted as first year students. The distribution of their states of residence (table 2) is considerable but could hardly be considered a typical North American cross section.

TABLE 1

Chronological age — at time photograph was taken.

	SERIES A		SERIES B		SERIES C		TOTAL A, B, C	
	No.	%	No.	%	No.	%	No.	%
13 yrs.	2	2.0	3	3.0	15	11.1	20	6.0
14 yrs.	50	50.6	20	20.2	68	50.4	138	41.4
15 yrs.	43	43.4	45	45.5	44	32.6	132	39.6
16 yrs.	4	4.0	30	30.3	8	5.9	42	12.6
17 yrs.	0	0.0	1	1.0	0	0.0	1	0.3
Total	99	100.0	99	100.0	135	100.0	333	99.9

TABLE 2

Geographical distribution: States of residence.

	SERIES A		SERIES B		SERIES C		TOTAL A, B, C	
	No.	%	No.	%	No.	%	No.	%
Mass.	34	34.3	39	39.4	58	43.0	131	39.3
N. Y.	25	25.3	19	19.2	24	17.8	68	20.4
Conn.	16	16.2	9	9.1	17	12.6	42	12.6
Pa.	2	2.0	4	4.0	6	4.4	12	3.6
N. J.	7	7.1	3	3.0	2	1.5	12	3.6
Ill.	3	3.0	5	5.1	6	4.4	14	4.2
Other states	11	11.1	18	18.2	20	14.8	49	14.7
Foreign	1	1.0	2	2.0	2	1.5	5	1.5
Total	99	100.0	99	100.0	135	100.0	333	99.9

About 75% of both these boys' paternal grandfathers and grandmothers were born in the United States, and about the same proportion of their maternal grandparents were also born here. Approximately 48% of the boys' fathers were of British extraction, 9% Irish, almost 8% German, and about 2.5% of Russian extraction. The distribution of the mothers'

extractions was very similar to that of the fathers. Our economic data, though incomplete and subject to the inaccuracies of material gathered by the questionnaire method (table 3), again emphasizes the need for defining our group as a special one; any attempt to generalize from our data should take cognizance of these various factors.

TABLE 3

Economic background: Yearly family income.

	SERIES A		SERIES B		SERIES C		TOTAL A, B, C	
	No.	%	No.	%	No.	%	No.	%
$1500 or less	2	2.8	4	5.0	7	6.7	13	5.1
$1500–$3000	7	9.9	9	11.3	17	16.2	33	12.9
$3000–$20,000	45	63.4	50	62.5	59	56.2	154	60.2
$20,000 or more	17	23.9	17	21.2	22	21.0	56	21.9
Total	71	100.0	80	100.0	105	100.1	256	100.1
Not recorded	28		19		30		77	
Grand total	99		99		135		333	

The present study reports the distribution of the various components in the somatotype photographs of this group of 333 adolescents and discusses the relation between the evaluations given the same photograph by two observers. We have desired to explore the value, practicability and efficiency of the somatotyping technique when utilized as part of a study of adolescents. The material we have obtained indicates the averages and ranges for this particular group, but should not be construed as necessarily representing "normal" data.

SOMATOTYPE TECHNIQUE [2]

The somatotyping technique developed by Sheldon ('40) classifies the physique on the basis of three "primary components," endomorphy, mesomorphy, and ectomorphy. Endo-

[2] The authors wish to acknowledge with appreciation the cooperation of Drs. W. H. Sheldon and W. C. Dupertuis in the somatotyping of the photographs. However, they share no responsibility for the analysis of the data or any of the conclusions contained in this article.

morphy refers to the tendency toward roundness and softness throughout the various regions of the body. Mesomorphy refers to the tendency toward hardness and squareness, the predominance of muscle, bone, and connective tissue. Ectomorphy is the tendency toward linearity and fragility. In deriving the somatotype of an individual each component is rated on a seven-point scale. A rating of 1 signifies the minimum development of the component in the individual and the rating of 7 the maximum manifestation. Although the usual procedure is to designate the somatotype in whole units, it is possible to use fractional values of one-half; in which case the rating is refined to a 15-point scale.

The somatotypes of the 333 students were made from anthroposcopic (inspectional) studies of the photographs of the subjects. Ratings were made by two different observers whose proficiency in somatotyping permitted the utilization of a 15-point scale. The photographs are standardized pictures of the subjects in the nude, revealing the whole body, front, back, and side views, all on a single 5×7 film. The photographs were taken according to the techniques suggested by Sheldon and therefore were satisfactory for use in somatotyping.

The major problem involved in the somatotyping of the students was the absence of established norms for this age group. For, although norms for 18-year-old male college students have been presented, no such norms are available for boys of the secondary school level. Since, according to Sheldonian theory the somatotype of the individual is a permanent and immutable feature, it was necessary for the observers in assigning ratings not only to assess the structure of the individual as he appeared in the photograph but also to estimate what his morphological appearance would be in early adulthood.

Reliability of the somatotype ratings

In the absence of any standardization or established norms for the age level of our students, the question arises as to the

consistency or "reliability" of the somatotype ratings. The usual method of determining the degree of reliability of a rating is to have different observers make ratings of the subjects independently of each other. The results of the comparison are then assessed by computing a "reliability coefficient" from the independent ratings. In the case of this material, somatotypes were determined by two persons referred to as observer A and observer B. However, the ratings were not completely independent. The ratings of observer A were available to observer B. To what extent the ratings of observer A influenced those of observer B, it is not possible to know. A period of somewhat over 3 years elapsed between the occasion of the ratings of the two observers. The reliability of the somatotype ratings at the adolescent level was accordingly not clearly established by the present analysis.

The data indicate that mesomorphic and ectomorphic components were rated almost identically by the observers.[3] In the case of the endomorphic component there was less consistency between the two observers, but these discrepancies were of a minor nature.

A very high degree of consistency of the somatotype ratings would not necessarily mean that the "permanent" somatotype of the individual can be accurately gauged at this age level. The proof of this would have to await the results of a study of the photographs of the same individuals taken in adolescence and subsequently in early adulthood.

Distribution of component ratings

The frequency distributions of the component ratings as estimated by observer A of this series are given in tables 4, 5, and 6. In the endomorphic component, these boys have ratings which are predominantly low. About 68% have ratings of 2 or 3 in approximately equal frequency. The next largest proportion of students (18%) have a rating of 4. Small scat-

[3] The coefficients of correlation between observer A and observer B ratings were: endomorphic component .90, mesomorphic component .99, and ectomorphic component .99.

TABLE 4

Incidences of the endomorphic component ratings.

RATING	NO.	%	%
1	4	1.2	8.4
1.5	24	7.2	
2	75	22.5	34.8
2.5	41	12.3	
3	84	25.2	33.0
3.5	26	7.8	
4	46	13.8	18.0
4.5	14	4.2	
5	12	3.6	4.2
5.5	2	.6	
6	4	1.2	1.5
6.5	1	.3	
7	0	0	0
	333	99.9	99.9
Mean		2.79	
Standard deviation		1.06	

TABLE 5

Incidences of the mesomorphic component ratings.

RATING	NO.	%	%
1	2	.6	3.0
1.5	8	2.4	
2	6	1.8	6.0
2.5	14	4.2	
3	46	13.8	23.4
3.5	32	9.6	
4	72	21.6	36.3
4.5	49	14.7	
5	67	20.1	25.5
5.5	18	5.4	
6	13	3.9	4.8
6.5	3	.9	
7	3	.9	.9
	333	99.9	99.9
Mean		3.87	
Standard deviation		1.17	

tered representations are found for the rest of the scale with the exception of the maximum rating of 7 which contained no individuals. The mean rating in endomorphy for the entire series is 2.79 and the standard deviation 1.06.

These adolescents tend to have higher mesomorphic than endomorphic ratings. They may be described as being medium in mesomorphy. The modal class with 36.3% is mesomorphy 4.

TABLE 6

Incidence of the ectomorphic component ratings.

RATING	NO.	%	%
1	15	4.5	9.6
1.5	17	5.1	
2	33	9.9	16.5
2.5	22	6.6	
3	70	21.0	27.9
3.5	23	6.9	
4	61	18.3	27.3
4.5	30	9.0	
5	33	9.9	14.1
5.5	14	4.2	
6	11	3.3	3.9
6.5	2	.6	
7	2	.6	.6
	333	99.9	99.9
Mean		3.34	
Standard deviation		1.31	

Mesomorphy 3 and 5 follow with almost equal frequency (23.4% and 25.5% respectively). The mean in mesomorphy for the entire series is 3.87 and the standard deviation 1.17.

In the ectomorphic component these boys are on the whole medium to low in ratings. The mean for the group in ectomorphy is 3.34 and the standard deviation 1.31 which indicates greater variability in ectomorphy than in the other two components. Ectomorphy 3 and 4 share equally the highest frequencies with 27.9% and 27.3% respectively. The next most frequent ectomorphic rating is 2 with 16.5% of individuals,

followed by ectomorphy 5 with 14.1%. Ectomorphy 1 is not far behind in this list with 9.6% of cases.

Distribution of the somatotypes

The essence of the somatotype is the manner in which the three components, endomorphy, mesomorphy, and ectomorphy are combined within the person. Accordingly, it is necessary to consider the distribution of the somatotypes as complete units in addition to dealing with the individual components.

Although this series is of respectable size (333) it is thought that the listing of all the different somatotypes found would be unwieldy and of little practical value. Consider the fact that in a series of 1,000 college students the highest frequency of any single somatotype amounted to only 5.5% of the group (Sheldon, '40, p. 78). A more useful procedure is to combine the various somatotypes into a limited number of categories on the basis of component dominance.

Table 7 gives the incidence of somatotypes found in this series according to a classification of component dominance, these figures being based on the somatotypes obtained on the 15-point scale. Almost one-half of the subjects (46.5%) have higher mesomorphic ratings than endomorphic or ectomorphic. Somewhat more than one-quarter of the group are dominant in the ectomorphic component (29.4%) and about one-sixth have no component dominance (i.e., when the highest ratings are equal in two of the components or when all three components are equal). The remainder (7.8%) are dominant endomorphs.

A more detailed breakdown of these data show three categories of somatotypes with almost identical frequency. The first is a somatotype where the mesomorphic component is dominant but in the case of the subsidiary components the ectomorphic is higher than the endomorphic (19.8%; example: 254, fig. 1). The second is again a somatotype where the mesomorphic component is dominant but with higher endomorphy than ectomorphy (19.5%; example: 452, fig. 2). The third is a dominant ectomorphic somatotype with subsidiary meso-

morphy higher than endomorphy (18.9%; example: 235, fig. 3). The next most frequent somatotype category containing 9.3% of individuals is characterized by equal mesomorphic and ectomorphic components but with lower endomorphy (example: 244). The other somatotype combinations show decreasing frequencies from 7.2% of the series to .6%.

TABLE 7

Incidence of somatotypes combined into categories on the basis of component dominance[1] *(based on 15-point scale).*

	NO.	%
Endomorphic component dominant		
Ectomorphy higher than mesomorphy	7	2.1
Mesomorphy higher than ectomorphy	14	4.2
Ectomorphy equals mesomorphy	5	1.5
Totals	26	7.8
Mesomorphic component dominant		
Endomorphy higher than ectomorphy	65	19.5
Ectomorphy higher than endomorphy	66	19.8
Ectomorphy equals endomorphy	24	7.2
Totals	155	46.5
Ectomorphic component dominant		
Mesomorphy higher than endomorphy	63	18.9
Endomorphy higher than mesomorphy	11	3.3
Mesomorphy equals endomorphy	24	7.2
Totals	98	29.4
No component dominance		
Endomorphy and mesomorphy equal (lower ecto)	19	5.7
Mesomorphy and ectomorphy equal (lower endo)	31	9.3
Endomorphy and ectomorphy equal (lower meso)	2	.6
All components equal	2	.6
Totals	54	16.2
Grand total	333	99.9

[1] This method of classification was suggested by Dr. W. C. Dupertuis.

The frequencies of these somatotype categories shift somewhat when the individuals are classified on the conventional 7-point scale instead of the 15. As may be seen in table 8, the dominant mesomorphs drop from 46.5% of the total series

Fig. 1 Dominant mesomorph (ectomorphy higher than endomorphy). Somatotype 2–5–4. Age 14 yrs. 11 mos.

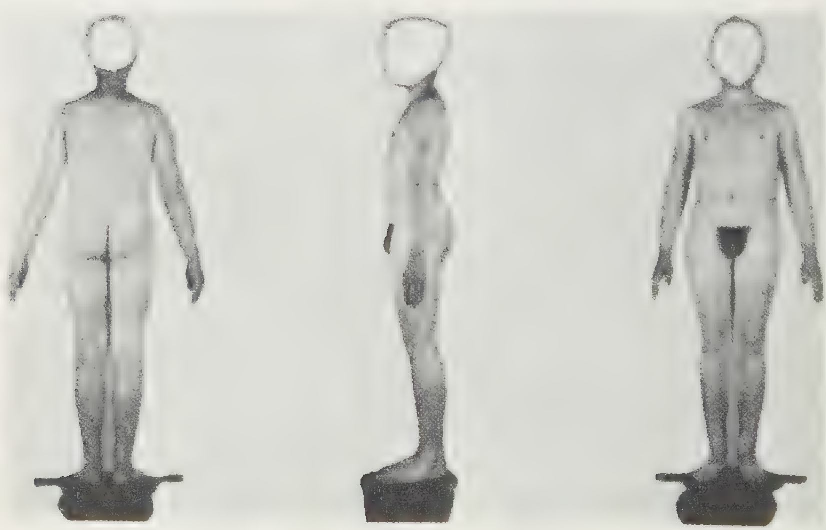

Fig. 2 Dominant mesomorph (endomorphy higher than ectomorphy). Somatotype 4–5–2. Age 15 yrs. 5 mos.

to 39.6%, the dominant ectomorphs from 29.4% to 26.7%. These differences are taken-up by the somatotypes with no component dominance, the percentage of these categories increasing from 16.2% of the total series to 26.4%.

Fig. 3 Dominant ectomorph (mesomorphy higher than endomorphy). Somatotype 2–3–5.[2]

Comparisons with other series

How do these adolescents compare in physical structure, as indicated by the somatotypes, with other groups? Inasmuch as, to the knowledge of the authors, this is the first published series of somatotypes of boys of the secondary school age level, it becomes necessary to contrast this group with data of young adults. For this purpose two series have been selected, Sheldon's series of 4,000 men (college students) and Dupertuis' study of 1,000 college freshmen from a large eastern university. The basis for the comparisons is the assumption that these adolescents' somatotypes are their "permanent" somatotypes. As previously indicated the proof for this must await longitudinal somatotype studies covering the period of early adolescence to adulthood.

TABLE 8

Incidence of somatotypes combined into categories on the basis of component dominance (based on 7-point scale).

	NO.	%
Endomorphic component dominant		
Ectomorphy higher than mesomorphy	6	1.8
Mesomorphy higher than ectomorphy	8	2.4
Ectomorphy equals mesomorphy	10	3.0
Totals	24	7.2
Mesomorphic component dominant		
Endomorphy higher than ectomorphy	43	12.9
Ectomorphy higher than endomorphy	46	13.8
Ectomorphy equals endomorphy	43	12.9
Totals	132	39.6
Ectomorphic component dominant		
Mesomorphy higher than endomorphy	45	13.5
Endomorphy higher than mesomorphy	7	2.1
Mesomorphy equals endomorphy	37	11.1
Totals	89	26.7
No component dominance		
Endomorphy and mesomorphy equal (lower ecto)	33	9.9
Mesomorphy and ectomorphy equal (lower endo)	47	14.1
Endomorphy and ectomorphy equal (lower meso)	2	.6
All components equal	6	1.8
Totals	88	26.4
Grand totals	333	99.9

TABLE 9

Per cent incidence of endomorphic component.

RATING	ADOLESCENT BOYS (333)	4,000 MEN (SHELDON)[1]	1,000 COLLEGE STUDENTS (DUPERTUIS)[2]
1	8.4	5.0	5.1
2	34.8	25.1	26.5
3	33.0	31.9	30.1
4	18.0	25.1	25.1
5	4.2	9.5	9.4
6	1.5	2.6	2.9
7		.8	1.0
	99.9	100.0	100.1
Mean	2.79	3.20	3.20
Standard deviation	1.1	1.2	1.2

[1] Sheldon, p. 127.

[2] Computed by the authors from data obtained from Sheldon, p. 78.

Tables 9, 10 and 11, compare these boys with the two series of young men according to the percental incidence of the component ratings of endomorphy, mesomorphy, and ectomorphy respectively. In endomorphy, the adolescents present somewhat lower ratings than Sheldon's 4,000 men and Dupertuis' 1,000 college students, the latter two groups being virtually identical in distribution of endomorphic ratings. The mean endomorphic rating for the boys is 2.79 compared with 3.20

TABLE 10

Per cent incidence of mesomorphic component.

RATING	ADOLESCENT BOYS (333)	4,000 MEN (SHELDON) [1]	1,000 COLLEGE STUDENTS (DUPERTUIS) [2]
1	3.0	2.0	3.4
2	6.0	13.1	12.3
3	23.4	26.3	27.6
4	36.3	32.4	31.3
5	25.5	18.5	18.2
6	4.8	6.3	6.1
7	.9	1.4	1.2
	99.9	100.0	100.1
Mean	3.87	3.77	3.72
Standard deviation	1.2	1.2	1.2

TABLE 11

Per cent incidence of ectomorphic component.

RATING	ADOLESCENT BOYS (333)	4,000 MEN (SHELDON) [1]	1,000 COLLEGE STUDENTS (DUPERTUIS) [2]
1	9.6	4.3	4.5
2	16.5	17.7	16.9
3	27.9	27.1	26.7
4	27.3	29.1	30.0
5	14.1	16.1	16.1
6	3.9	4.6	4.6
7	.6	1.1	1.3
	99.9	100.0	100.1
Mean	3.34	3.53	3.55
Standard deviation	1.3	1.3	1.3

for the two adult series. More specifically our series shows slight excesses of endomorphy 1 and 2, and comparable deficiencies of endomorphy 4 and higher.

There is a slight excess of mesomorphy in our group as compared with the two adult series. These small excesses appear in mesomorphy 4 and 5, while the largest deficiency is found in mesomorphy 2. The mean mesomorphic rating for the boys is 3.87, for Sheldon's 4,000 men 3.77 and 3.72 for Dupertuis' 1,000 college students.

TABLE 12

Comparison between adolescent boys and college freshmen for incidence of somatotypes.

	ADOLESCENT BOYS (333)		COLLEGE FRESHMEN (DUPERTUIS) (1001)	
	No.	%	No.	%
Endomorphic component dominant				
Ectomorphy higher than mesomorphy	6	1.8	40	4.0
Mesomorphy higher than ectomorphy	8	2.4	59	5.9
Ectomorphy equals mesomorphy	10	3.0	58	5.8
Total	24	7.2	157	15.7
Mesomorphic component dominant				
Endomorphy higher than ectomorphy	43	12.9	83	8.3
Ectomorphy higher than endomorphy	46	13.8	84	8.4
Ectomorphy equals endomorphy	43	12.9	126	12.6
Total	132	39.6	293	29.3
Ectomorphic component dominant				
Mesomorphy higher than endomorphy	45	13.5	101	10.1
Endomorphy higher than mesomorphy	7	2.1	46	4.6
Mesomorphy equals endomorphy	37	11.1	128	12.8
Total	89	26.7	275	27.5
No component dominance				
Endomorphy and mesomorphy equal (lower ecto)	33	9.9	82	8.2
Mesomorphy and ectomorphy equal (lower endo)	47	14.1	99	9.9
Endomorphy and ectomorphy equal (lower meso)	2	.6	57	5.7
All components equal	6	1.8	38	3.8
Total	88	26.4	276	27.6
Grand total	333	99.9	1001	100.1

There is very little difference between the series in the ectomorphic ratings. The only noteworthy discrepancy appears in the incidence of ectomorphy 1. The boys have twice as large a frequency of this category than the adult series (9.6% as compared with 4.3% and 4.5%).

To summarize, our adolescents were somewhat lower in endomorphy and slightly higher in mesomorphy than Sheldon's 4,000 men and Dupertuis' 1,000 college freshmen. The size of the differences, it should be noted, do not indicate marked divergencies in component ratings between our group and the two series of young adults.

Essentially the same results are obtained when the adolescent boys are compared with Dupertuis' college students on the basis of the classification of the somatotypes for component dominance. The data are given in table 12. Somatotypes with dominance of the endomorphic component are about twice as frequent in the college freshmen as in the adolescents (15.7% and 7.2% respectively), while the boys show a 10.3% excess of somatotypes with dominance of the mesomorphic component than the college freshmen. Dominant ectomorphs and somatotypes with "no component dominance" are about equally represented in the two groups.

SUMMARY

The somatotyping technique of classifying body structure was applied to 333 students of three first-year classes at a New England private college preparatory boarding school. Ratings were made by two experienced observers using the anthroposcopic method. The results follow:

1. An extremely high degree of agreement in somatotype ratings was attained by two observers (the second observer was aware of the previous ratings). The correlation coefficients between the two ratings ranged from .90 to .99.

2. According to the individual components, this group of adolescent boys appeared to be low in endomorphy, medium in mesomorphy, and medium to low in ectomorphy.

3. When the somatotypes were classified into categories on the basis of component dominance, the data showed that almost one-half of the series were dominant mesomorphs, somewhat more than one-quarter were dominant ectomorphs, about one-sixth had no component dominance, and the very small remainder (about one-twelfth) were dominant in the endomorphic component.

4. Only small differences were revealed between the distribution of the somatotype ratings of these boys and those of Sheldon's 4,000 men and Dupertuis' 1,000 college freshmen. The adolescents displayed somewhat lower endomorphy and slightly higher mesomorphy than those two series of young adults.

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SURVEY OF POLYNESIA NEARS END.— The field survey on Polynesia has been practically completed. Expeditions under the auspices of Bishop Museum have done field work in every island group except Easter Island, Niue, Chatham Island, New Zealand, and the Ellice Islands. Easter Island, Niue and Chatham Island were visited by trained anthropologists from other institutions, but Bishop Museum published the results of their field work. New Zealand was left to her own capable students. Of the Ellice Islands, the atolls of Funafuti and Vaitupu have been studied by capable men, but the other atolls in the group may provide additional material to round off the picture . . .

[As for physical anthropology] though additional measurements are useful, it may be said that the field work already done is sufficient for practical purposes. However, should further field work be conducted in the Ellice Islands, the taking of physical measurements should be undertaken. Field work in physical anthropology is thus open for the Ellice Islands.— Te Rangi Hiroa (Peter H. Buck). An introduction to Polynesian anthropology. Bull. Bernice P. Bishop Mus., no. 187, 1945, pp. 123, 125.

SYMMETRICAL AND ASYMMETRICAL OCCURRENCE OF PAPILLARY PATTERNS [1]

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FOUR FIGURES

Finger patterns show a tendency to symmetrical occurrence; patterns of the same type appear on corresponding digits of right and left hands more frequently than would be the case if this expression of symmetry were determined solely by chance (Dankmeijer and Renes, '38).

Nevertheless, there is only a tendency to symmetry, for many couplets of corresponding digits bear patterns of unlike type. The present account contains the results of an attempt to analyze the occurrence of these asymmetrical combinations, to find out whether their occurrence is determined by fixed rules and what these rules may be.

I regret having to emphasize that this communication cannot pretend to solve the problem in question. As will be discussed later on, the material employed, 5900 persons, proved to be not extensive enough to attain sufficiently reliable figures. Moreover, I did not have at my disposal sufficiently diverse anthropological materials. I feel sure, however, that the results communicated now could serve as a basis for further research.

The present study was suggested to me by the following two facts:

In the first place, Poll ('14) came to the conclusion that "Erst der Beobachter, der über eine vollständige Kenntnis

[1] Editorial revisions were made by Prof. Harold Cummins. Proof could not be sent to the author.

der Symmetrie- und Asymmetrieregeln beider Art bezüglich der Musterverteilung auf die Einzelfinger, und der Gesetzmässigkeiten im Ersatz der 'verwandten' Figuren verfügt, wird eine exakte und einheitliche Analyse des Erbganges der Daktylogramme zu liefern im Stande sein." An analysis of the symmetrical occurrence of finger patterns has been made by Dankmeijer and the author ('38). Application of the results of the investigation to twin comparisons pointed out the justness of Poll's conclusion. It was proved that the similarity as regards symmetry of the papillary patterns, in keeping with the findings in morphological comparisons of the patterns in twins, is greater between monozygotic twins than between the right and left hands of single persons, and greater than between double-ovum twins (Dankmeijer and Renes, '40). This finding supplements the other available evidence that heredity plays a rôle in the development of the apical patterns. Nevertheless, a complete genetical analysis of the patterns can not yet be given. It therefore seems quite possible that fulfillment of Poll's second requirement, viz., the analysis of the asymmetrical combinations, would bring us another step forward on the way to complete knowledge of the genetics of finger prints.

Secondly, the various asymmetrical combinations by no means occur in relatively the same frequency; the combinations of a loop on a certain digit of the one hand and a whorl on the corresponding digit of the other hand are relatively as well as absolutely much more frequent than the whorl-arch combination.

From this preliminary observation one immediately receives the impression that the frequencies of the various asymmetrical combinations are by no means determined solely by chance. And as a consequence the following question offers itself: What are the rules that determine the distribution of the asymmetrical cases? This question we shall try to answer.

MATERIAL

The material for the present research consists of the finger prints of 2600 Javanese males, 2400 Javanese females and 900 Chinese males, who had all been employed as contract-coolies in Deli. This material originated from the "Dactyloscopisch Bureau der D.P.V. en A.V.R.O.S." at Medan. This material is in the hands of Dr. J. Dankmeijer, conservator of the Laboratory of Anatomy of The State University of Leyden (Netherlands), who in 1939 most kindly put it at my disposal for this research and to whom I feel greatly indebted for this generosity.

Regarding the Chinese, the results of an anthropological investigation were previously published by Dankmeijer and the author ('39). Anthropological observations on the finger-prints of 1000 Javanese males and 1000 Javaneses females included in the present series have been published by Dankmeijer ('38) in a previous number of this journal.

METHOD

The whole material has been classified according to the rules given by Dankmeijer ('34), with the exception that no distinction has been made between radial and ulnar loops. I hope soon to publish the arguments that caused me to combine these two types, generally considered as separate groups.

In this material I determined the frequencies of all possible combinations of patterns, both symmetrical and asymmetrical, separately for the various pairs of corresponding digits. These are the frequencies determined by counting (actual frequencies, henceforth abbreviated as af). I determined also the frequencies of the various combinations which would have been met with had their distribution been determined solely by chance (chance frequencies, henceforth abbreviated as cf). In addition I calculated for each combination and for the various pairs of corresponding digits separately the $\frac{\text{actual frequency}}{\text{chance frequency}}$ ratio, which value henceforth will be called the af–cf ratio.

The cf has been calculated in the following way. Let us suppose the frequencies of loops, whorls and arches on the right thumb to be respectively a%, b% and c%; those on the left thumb d%, e%, and f%. The cf for the combination of a loop on both thumbs then would be a% × d%. In table 1 I have indicated the combinations that may occur in the thumbs of right and left hands and their cf.

This reasoning is identical with that which was used in our previous studies of symmetrical occurrence of papillary patterns.

TABLE 1

Possible combinations of papillary patterns on right and left thumbs and their cf.

COMBINATIONS		CHANCE FREQUENCIES (cf)
Right thumb	Left thumb	
loop	loop	a% × d%
loop	whorl	a% × e%
loop	arch	a% × f%
whorl	loop	b% × d%
whorl	whorl	b% × e%
whorl	arch	b% × f%
arch	loop	c% × d%
arch	whorl	c% × e%
arch	arch	c% × f%

OBSERVATIONS

Let us first consider the symmetrical cases. Dankmeijer and the author ('38) pointed out that: (1) actual symmetry is always greater than the chance symmetry; (2) a certain chance symmetry always includes a certain actual symmetry, independent of sex and race; (3) it was possible to set the chance symmetry in a curve against the actual symmetry.

The same curve is obtained in the several races and in both sexes of each race; it is illustrated in figure 1, constructed on the basis of the figures for the Javanese material now employed. Though this curve is of a very regular shape, it proved to be impossible to find a formula to which it answers.

We shall now try to analyze the occurrence of these symmetrical cases by considering the three patterns separately.

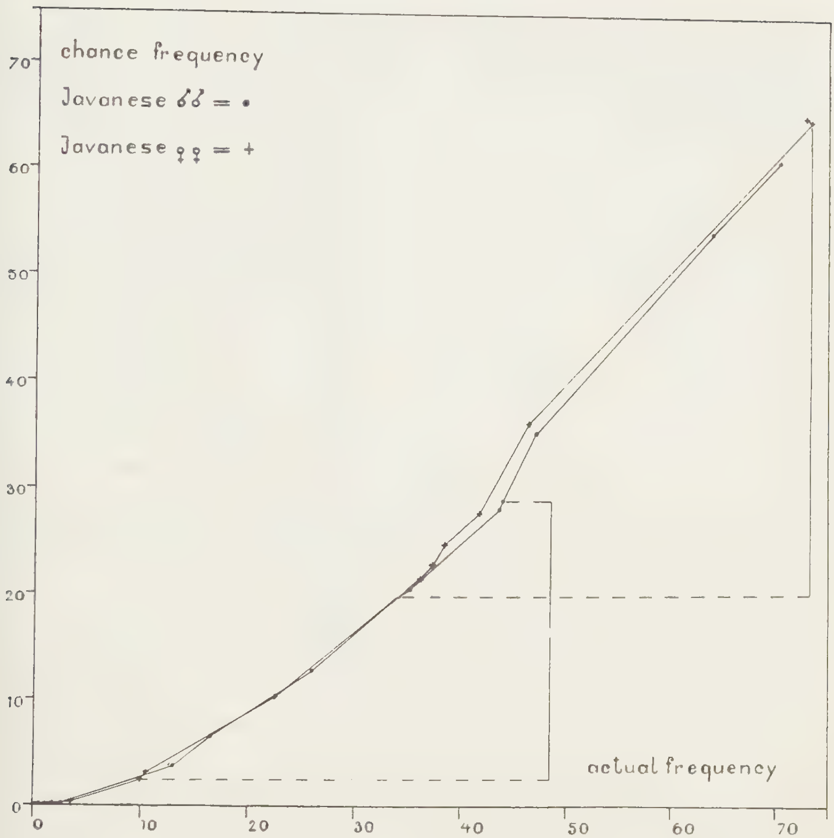

Fig. 1 Frequencies of chance symmetry (cf) plotted against frequencies of actual symmetry (af).

Symmetry in loops

Table 2 presents the figures for the symmetrical occurrence of loops in Javanese males. The af–cf ratio is not constant. It varies from 1.15 to 1.73.

From table 3, listing the corresponding figures for the Javanese females, we learn that here the ratio varies from 1.11 to 1.55, whereas table 4, giving data for Chinese males, shows this ratio ranging between 1.22 and 2.08.

If we now examine these values more closely, we are struck by the fact that the af–cf ratio is higher in proportion to the decrease of the cf.

Because of the inconstancy of the af–cf ratio it is impossible to determine by means of calculation the percentage of symmetry in loops from the frequencies of this pattern on the individual digits.

TABLE 2

Symmetrical occurrence of loops in 2600 Javanese males.

DIGIT	CF	AF	AF–CF RATIO
I	19.71	34.04	1.73
II	34.98	47.00	1.34
III	61.07	70.38	1.15
IV	20.51	34.92	1.70
V	54.18	64.12	1.18

TABLE 3

Symmetrical occurrence of loops in 2400 Javanese females.

DIGIT	CF	AF	AF–CF RATIO
I	24.81	38.54	1.55
II	36.25	46.29	1.28
III	65.00	73.25	1.12
IV	27.51	41.42	1.51
V	65.33	72.67	1.11

TABLE 4

Symmetrical occurrence of loops in 900 Chinese males.

DIGIT	CF	AF	AF–CF RATIO
I	14.6	28.2	1.93
II	23.0	34.4	1.49
III	36.1	49.8	1.37
IV	12.9	26.8	2.08
V	45.6	56.7	1.22

Symmetry in whorls

From the figures in tables 5, 6 and 7 we learn that the af–cf ratio for whorls also is not constant. It varies in Javanese males from 1.52 to 3.39, in Javanese females from 1.64 to 4.08, and in Chinese males from 1.37 to 2.19.

Again it becomes clear that increase of the value of the af–cf ratio is incidental to the decrease of the value of the cf.

Again we must conclude that it is not possible to calculate the percentage of actual symmetry in whorls from the frequencies on the individual digits.

TABLE 5

Symmetrical occurrence of whorls in 2600 Javanese males.

DIGIT	CF	AF	AF–CF RATIO
I	28.90	43.96	1.52
II	12.63	26.00	2.06
III	3.81	12.92	3.39
IV	28.00	43.77	1.56
V	6.57	16.58	2.52

TABLE 6

Symmetrical occurrence of whorls in 2400 Javanese females.

DIGIT	CF	AF	AF–CF RATIO
I	22.70	37.17	1.64
II	10.29	22.50	2.19
III	2.46	10.04	4.08
IV	21.29	36.08	1.70
V	3.25	10.58	3.29

TABLE 7

Symmetrical occurrence of whorls in 900 Chinese males.

DIGIT	CF	AF	AF–CF RATIO
I	34.6	50.2	1.45
II	18.2	31.6	1.74
III	12.8	27.4	2.15
IV	39.4	54.1	1.37
V	9.4	20.6	2.19

Symmetry in arches

From the figures in tables 8, 9 and 10, we learn that the af–cf ratio for arches is not constant. The values in Javanese males range from 8.64 to 63.33, in Javanese females from 6.21 to 46.00 and in Chinese males from 5.69 to 56.00.

Once more it becomes clear that the af–cf ratio increases incidentally to the decrease of the value of the cf. That this

phenomenon is not so regular here as it is in the case of loops and whorls is certainly caused by the influence of the standard deviation.

For the third time we must conclude that calculation of the percentage of symmetry from the frequencies on the individual digits is not possible.

TABLE 8

Symmetrical occurrence of arches in 2600 Javanese males.

DIGIT	CF	AF	AF–CF RATIO
I	0.01	0.54	54.00
II	0.28	2.42	8.64
III	0.05	1.12	22.40
IV	0.003	0.19	63.33
V	0.002	0.12	60.00

TABLE 9

Symmetrical occurrence of arches in 2400 Javanese females.

DIGIT	CF	AF	AF–CF RATIO
I	0.06	1.54	25.67
II	0.57	3.54	6.21
III	0.11	1.63	14.82
IV	0.01	0.46	46.00
V	0.01	0.42	42.00

TABLE 10

Symmetrical occurrence of arches in 900 Chinese males.

DIGIT	CF	AF	AF–CF RATIO
I	0.06	1.78	29.67
II	0.84	4.78	5.69
III	0.14	1.56	11.15
IV	0.01	0.33	33.00
V	0.01	0.56	56.00

Comparison of symmetry in loops, whorls and arches

If we compare the values of the af–cf ratio for loops, whorls and arches, we will see that this ratio has its lowest value in loops, a higher one in whorls, whereas the highest value is

reached in arches. This could lead us to the conclusion that the tendency to symmetrical occurrence is the highest in arches, lower in whorls and the lowest in loops. Yet this would not be true.

Dankmeijer and the author ('38) already concluded that a certain percentage of actual symmetry is connected with a certain percentage of chance symmetry, irrespective of the type of the papillary patterns. This can easily be demonstrated in the following way:

As the tendency to symmetry is expressed by the af–cf ratio we will have to compare cases in which the same cf was calculated for different patterns. If the tendency to symmetry were independent of the type of pattern and if indeed it were determined solely by the value of the cf then in all cases with the same cf the same value of the af–cf ratio should be found. From the subjoined examples we see that this holds true.

Digit I in Javanese males shows a cf for whorls of 28.90, whereas the af–cf ratio is 1.52; the cf for loops in digit IV in Javanese females is 27.51 and the af–cf ratio is 1.51. It is clear that these values of the af–cf ratio agree fairly well. The same conclusion is to be drawn for other examples showing identical or nearly identical values of the cf. Digit I in Javanese males shows a cf for loops of 19.71 and an af–cf ratio of 1.73. Digit IV in Javanese females having a cf of 21.29 and digit II in Chinese males with a cf for whorls of 18.2 show af–cf ratios of 1.70 and 1.74 respectively. In the scarce cases in which the value of the cf for loops is identical with that of whorls, the value of the af–cf ratio is also identical. In other words, the tendency to symmetry was equally great.

Only in a few cases in this material does the value of the cf for whorls reach the height of the one for loops. Had I had at my disposal a population showing a high whorl frequency and a low frequency of loops, then the value of the cf for whorls would have reached the height of those for loops and we would have been able to compare those values and their af–cf ratios. It may be predicted with confidence

that such material would show that loops and whorls show equally great tendencies to symmetry.

In the populations here investigated, values of the cf for arches are not sufficiently high to provide for comparison of the cf values for whorls. From statistics available in the literature it may be shown, however, that whorls have the same tendency to symmetry as arches. I therefore take two examples from the publication of Dankmeijer and the author ('38). In that publication data are given concerning the Efé-pygmies, who show the highest known arch frequency.

In 153 males the cf for arches on digit I is 2.9, the af is 12.4, af–cf ratio being 4.28. In comparing this with the values for whorls in digit III in Javanese females (respectively 2.46, 10.04 and 4.08) we find a close agreement. I therefore feel quite confident that the tendency to symmetry in arches is as strong as it is in whorls.

The curve given in figure 1 also can be used to demonstrate that the tendency to symmetry is independent of the type of pattern. For, as the highest cf value for whorls reaches the level of the lowest cf values for loops, both patterns must have a certain part of the curve in common. This is shown by the brackets in figure 1; the upper one limits the range of the values for loops, the lower one that of the values for whorls. These ranges overlap. As stated above, this material is not adapted to comparison of the symmetry tendency in whorls and arches.

Thus we have arrived at the following conclusions. The tendency to symmetry varies in the sense that it decreases with the increase of the frequency of the pattern. The percentage of symmetry therefore cannot be calculated from the frequencies of the patterns on the separate digits, but must be judged by means of the symmetry curve.

Asymmetrical combinations of loops and arches

Let us now consider the asymmetrical combinations. First we will pay attention to the combinations of loops and arches

and those of arches and loops. Tables 11, 12 and 13 list the complete figures concerning these cases in Javanese males, Javanese females and Chinese males. A glance at these tables at once shows that the value of the af is nearly always lower than that of the cf. The value of the af–cf ratio ranges from 0.39 to 1.88 in Javanese males, from 0.36 to 1.42 in Javanese females, and from 0.25 to 2.50 in Chinese males. Ex-

TABLE 11

Occurrence of asymmetrical combinations between loops and arches in 2600 Javanese males.

DIGIT	COMBINATION	CF	AF	AF–CF RATIO
I	loop-arch	0.77	1.19	1.55
	arch-loop	0.38	0.15	0.39
II	loop-arch	2.91	2.42	0.83
	arch-loop	3.38	3.08	0.91
III	loop-arch	2.23	1.69	0.76
	arch-loop	1.43	0.73	0.51
IV	loop-arch	0.33	0.62	1.88
	arch-loop	0.15	0.12	0.80
V	loop-arch	0.35	0.38	1.09
	arch-loop	0.24	0.19	0.79
	mean value of the af–cf ratio = 0.95			

TABLE 12

Occurrence of asymmetrical combinations between loops and arches in 2400 Javanese females.

DIGIT	COMBINATION	CF	AF	AF–CF RATIO
I	loop-arch	1.47	1.17	0.80
	arch-loop	1.03	0.46	0.45
II	loop-arch	6.25	5.50	0.88
	arch-loop	3.66	2.63	0.72
III	loop-arch	3.95	3.08	0.78
	arch-loop	1.87	0.67	0.36
IV	loop-arch	1.03	1.46	1.42
	arch-loop	0.39	0.25	0.64
V	loop-arch	1.27	1.17	0.92
	arch-loop	0.54	0.25	0.46
	mean value of the af–cf ratio = 0.74			

amination of the figures shows that increase in the af–cf ratio is not connected in any way with increase or decrease of the cf value. In table 11 we find, for instance, cf values of 0.38, 0.33 and 0.35, whereas the corresponding af–cf values are respectively 0.39, 1.88 and 1.09. Moreover, we should not forget that the standard deviation plays an important rôle here as it has an influence on the frequencies on the separate digits and thus on their products, the cf and af values. These considerations make it possible and even probable that the extreme high

TABLE 13

Occurrence of asymmetrical combinations between loops and arches in 900 Chinese males.

DIGIT	COMBINATION	CF	AF	AF–CF RATIO
I	loop-arch	1.1	1.1	1.00
	arch-loop	0.8	0.2	0.25
II	loop-arch	4.5	4.2	0.93
	arch-loop	4.3	3.8	0.88
III	loop-arch	3.1	3.4	1.10
	arch-loop	1.6	1.0	0.63
IV	loop-arch	0.4	1.0	2.50
	arch-loop	0.3	0.4	1.33
V	loop-arch	0.7	0.4	0.57
	arch-loop	0.7	0.3	0.43
	mean value of the af–cf ratio = 0.96.			

and low values of the af–cf ratio have no other significance than as resultants of the relatively high value of the standard deviation. If this were true, then the af–cf ratio would show a tendency to constancy and it would be permissible to determine its mean value. This then would be in Javanese males 0.95, in Javanese females 0.74 and in Chinese males 0.96. These values are not widely discrepant and if we take into account the standard deviation their agreement is indeed striking.

If the af–cf ratio for the combinations of loops and arches would prove to have a constant value of 0.88, then the setting of the af values against those of the cf in a diagram would

result in a straight line originating from the zero point. In figure 2 the thick line constructed for an af–cf ratio of 0.88 agrees fairly well with the situation of the af–cf points. As this line is situated at the left side of the 45° line, we must conclude that the af values are smaller than the cf values. That means that there is no tendency to asymmetry in the case of loop-arch combinations. On the contrary, there seems

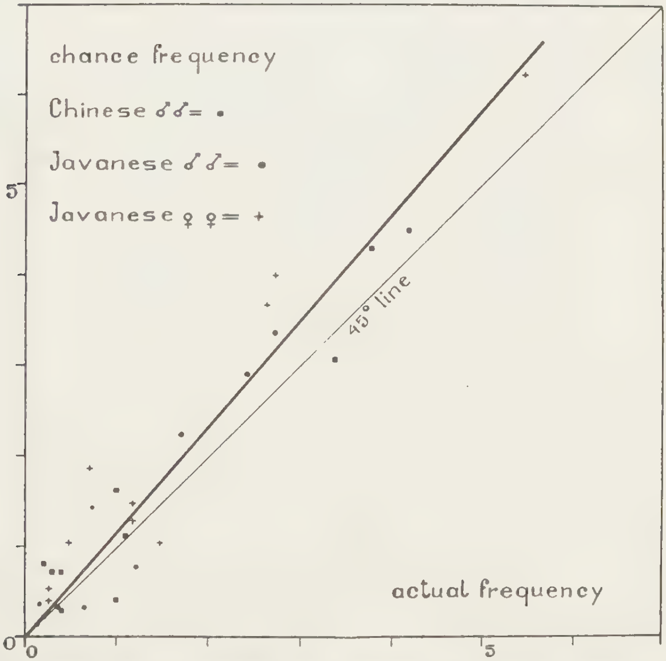

Fig. 2 The af and cf values for combinations of loops and arches. The thick line is constructed on the basis of an af–cf ratio of 0.88. A line at 45° is added for reference.

to exist a slight tendency to repulsion between loops and arches, a tendency that most probably is irrespective of the height of the cf value. As there is a fixed relation between the af and cf values, it is possible to calculate the percentage of the combinations loop-arch and arch-loop from the frequencies of these patterns on the individual digits.

Asymmetrical combinations of loops and whorls

Let us now pay attention to the combinations of loops and whorls. The statistics of these combinations are given in tables 14, 15 and 16. A glance at the tables shows that the af values are always lower than those for the cf. When we consider the values of the af–cf ratio it becomes clear that there is in this respect an evident tendency to constancy.

TABLE 14

Occurrence of the asymmetrical combinations between loops and whorls in 2600 Javanese males.

DIGIT	COMBINATION	CF	AF	AF–CF RATIO
I	loop-whorl	19.43	4.69	0.30
	whorl-loop	29.31	15.15	0.52
II	loop-whorl	20.27	8.77	0.43
	whorl-loop	21.79	10.23	0.47
III	loop-whorl	15.94	7.19	0.45
	whorl-loop	14.58	6.00	0.41
IV	loop-whorl	19.64	5.62	0.29
	whorl-loop	29.24	14.88	0.51
V	loop-whorl	15.51	5.58	0.36
	whorl-loop	22.93	13.08	0.57
	mean value of the af–cf ratio = 0.43			

TABLE 15

Occurrence of the asymmetrical combinations between loops and whorls in 2400 Javanese females.

DIGIT	COMBINATION	CF	AF	AF–CF RATIO
I	loop-whorl	22.65	9.13	0.40
	whorl-loop	24.87	11.63	0.47
II	loop-whorl	19.94	10.42	0.52
	whorl-loop	18.71	9.33	0.49
III	loop-whorl	14.92	7.56	0.51
	whorl-loop	10.72	3.75	0.35
IV	loop-whorl	22.23	7.54	0.34
	whorl-loop	26.35	12.79	0.49
V	loop-whorl	13.96	6.75	0.48
	whorl-loop	15.20	8.17	0.54
	mean value of the af–cf ratio = 0.46			

In Javanese males the ratios vary from 0.29 to 0.57, in Javanese females from 0.34 to 0.54, and in Chinese males from 0.27 to 0.56. It is clear that this variation is not connected with any variation of the cf value. We get the strong impression that the fluctuations are only an expression of the influence of the standard deviation. The mean values of the af–cf ratios for the three populations are: Javanese males, 0.43; Javanese females, 0.46; Chinese males, 0.41.

TABLE 16

Occurrence of the asymmetrical combinations between loops and whorls in 900 Chinese males.

DIGIT	COMBINATION	CF	AF	AF–CF RATIO
I	loop-whorl	18.9	5.4	0.29
	whorl-loop	26.7	13.9	0.52
II	loop-whorl	19.2	7.9	0.41
	whorl-loop	21.8	11.1	0.51
III	loop-whorl	23.4	9.6	0.41
	whorl-loop	19.8	6.8	0.34
IV	loop-whorl	19.7	5.4	0.27
	whorl-loop	25.8	12.1	0.47
V	loop-whorl	15.8	4.4	0.28
	whorl-loop	27.2	15.3	0.56
	mean value of the af–cf ratio = 0.41			

When setting the af values against the cf values, and drawing a line on the basis of af = 0.43 cf we see that this line, which is the thick one in figure 3, agrees with the distribution of af–cf points. It is concluded that there is a rather strong tendency to repulsion between loops and whorls. This tendency is independent of the height of the cf value.

As there is a fixed relation between the af and cf values, it is possible to calculate the percentage of the loop-whorl and of the whorl-loop combinations from the frequencies of the patterns on individual digits.

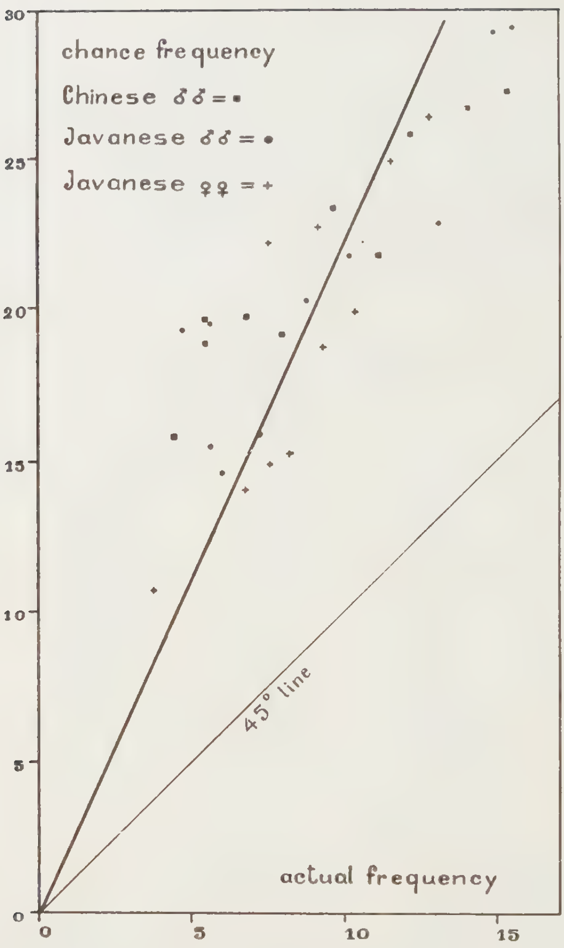

Fig. 3 The af and cf values for combinations of loops and whorls. The thick line is constructed on the basis of an af–cf ratio of 0.43. A line at 45° is added for reference.

Asymmetrical combinations of whorls and arches

We are now to consider the combinations of whorls and arches. Figures concerning these combinations are given in tables 17, 18 and 19. Again it is clear that the cf values are higher than those of the af. For these combinations the values of the af are only small fractions of the cf values. The

combination of an arch and a whorl is so rare that it occurs only on those digits on which the cf value reaches a considerable height. Thanks to the relatively high frequencies of arches and whorls in digits I and II, the cf for these digits are

TABLE 17

Occurrence of the asymmetrical combinations between whorls and arches in 2600 Javanese males.

DIGIT	COMBINATION	CF	AF	AF–CF RATIO
I	whorl-arch	1.14	0.19	0.17
	arch-whorl	0.37	0.04	0.11
II	whorl-arch	1.81	0.15	0.08
	arch-whorl	1.96	0.12	0.06
III	whorl-arch	0.53	0.00	0.00
	arch-whorl	0.37	0.00	0.00
IV	whorl-arch	0.47	0.00	0.00
	arch-whorl	0.15	0.00	0.00
V	whorl-arch	0.15	0.00	0.00
	arch-whorl	0.69	0.00	0.00

TABLE 18

Occurrence of the asymmetrical combinations between whorls and arches in 2400 Javanese females.

DIGIT	COMBINATION	CF	AF	AF–CF RATIO
I	whorl-arch	1 47	0.25	0.17
	arch-whorl	0.94	0.08	0.09
II	whorl-arch	2.91	0.08	0.03
	arch-whorl	2.02	0.08	0.03
III	whorl-arch	0.65	0.00	0.00
	arch-whorl	0.04	0.00	0 00
IV	whorl-arch	0.93	0.00	0 00
	arch-whorl	0.31	0.00	0.00
V	whorl-arch	0.30	0.00	0.00
	arch-whorl	0.12	0.00	0.00

high enough to deliver an af–cf ratio varying from 0.06 to 0.17 in Javanese males, from 0.03 to 0.17 in Javanese females and from 0.06 to 0.25 in Chinese males. For the other digits the cf values are too low to give statistically reliable results.

It is therefore impossible even to estimate the value of the af–cf ratio, but at least it can be stated with certainty that the ratio is by far the lowest one. It is also clear that there is a strong tendency to repulsion between arches and whorls. This is expressed by the situation of the af–cf points on the vertical abscissa or quite near it. Whether or not these points are distributed along a straight line cannot be determined. In figure 4, however, the dotted line construction for an af–cf ratio of 0.05, its mean value, seems to fit well.

TABLE 19

Occurrence of the asymmetrical combinations between whorls and arches in 900 Chinese males.

DIGIT	COMBINATION	CF	AF	AF–CF RATIO
I	whorl-arch	2.0	0.2	0.10
	arch-whorl	1.1	0.0	0.00
II	whorl-arch	4.3	0.7	0.16
	arch-whorl	3.6	0.3	0.08
III	whorl-arch	1.7	0.1	0.06
	arch-whorl	1.0	0.2	0.20
IV	whorl-arch	0.9	0.0	0.00
	arch-whorl	0.5	0.0	0.00
V	whorl-arch	0.4	0.1	0.25
	arch-whorl	0.2	0.0	0.00

General review of asymmetry in papillary patterns

We have now arrived at a general consideration of the occurrence of asymmetrical combinations. From the foregoing it may be concluded that there is no tendency to asymmetrical occurrence of papillary patterns. The fact that there is a tendency to symmetrical occurrence does not connote that a tendency to asymmetrical occurrence must be absent. On the contrary, it is conceivable that even in the presence of a tendency to symmetrical occurrence, a loop, for example, might not be partnered with a loop on the corresponding digit but is partnered with an arch instead. The occurrence of such cases in a higher frequency than their cf would in-

dicate a tendency to symmetrical occurrence as well as to asymmetry. However, it has been proved that this is not true, since always the af value is lower than the cf value. There is accordingly no tendency to asymmetrical occurrence of papillary patterns, and it may be added that the occurrence

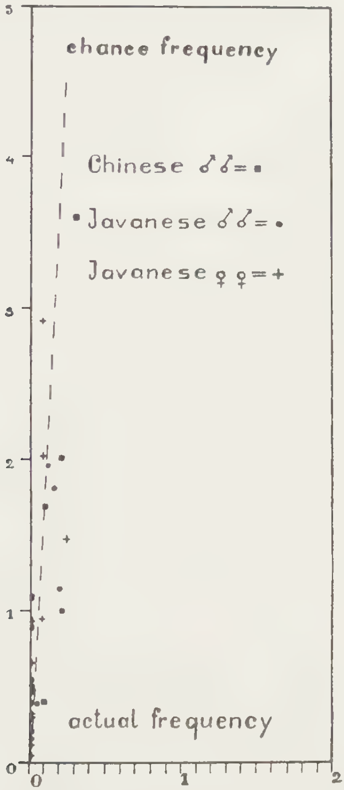

Fig. 4 The af and cf values for combinations of whorls and arches. The dotted line is constructed on the basis of an af–cf ratio of 0.05.

of the three asymmetrical combinations is influenced by a tendency to repulsion between different patterns.

It has been shown that this tendency to repulsion is the weakest between arches and loops, that it is stronger between loops and whorls, and very strong between arches and whorls. The tendency is constant for loop-arch and loop-whorl com-

binations; for arch-whorl combinations this could not be proved. Yet it is quite certain that for arch-whorl combinations this tendency to repulsion is so strong that these combinations are exceedingly rare.

I have attempted to make it clear that the relation between af and cf is a very simple one for the arch-loop and the loop-whorl combinations, thus making it possible to calculate the frequencies of these combinations from the frequencies of the patterns in question on the individual digits.

Concerning the value of the af–cf ratio for arch-whorl combinations, I can only say that it must be a very low one.

Symmetrical occurrence of papillary patterns caused by the tendency to repulsion between different patterns

Previously it has been emphasized that the symmetry curve does not conform to a simple formula. This curve therefore shows that there is a tendency to symmetrical occurrence of papillary patterns and it proves that the tendency is not influenced by sex, race and pattern type. New ways to genetical investigation of finger prints (twin-research) were opened, but they did not reveal the ultimate principles of symmetry.

It is my opinion that the regularity in symmetrical occurrence of papillary patterns is a consequence of the tendency to repulsion. In other words, symmetrical occurrence is not primary. The tendency to repulsion is constant for the various asymmetrical combinations and allows us to calculate the frequencies of these combinations from the frequencies of the patterns concerned. Therefore it is this tendency that is to be considered as being primary.

As by means of the known value of the af–cf ratio the frequencies of the asymmetrical combinations can be calculated from the percentile occurrences of the patterns on the individual digits, the frequencies of the symmetrical combinations can easily be found by means of a simple subtrac-

tion. This is illustrated in the following example. In digit II of the right hand of Javanese males, the percentage of loops is 58.15. The cf for loop-whorl combinations is 20.27; that for loop-arch combinations is 2.91. The af–cf ratio for loop-whorl combinations is 0.43; for loop-arch combinations it is 0.88. So the frequency of the loop-whorl combinations would be $0.43 \times 20.27\% = 8.7161\%$, that for loop-arch combinations should be $0.88 \times 2.91\% = 2.5608\%$. So $8.7161\% + 2.5608\% = 11.28\%$ of the loops on the right digit II should meet with an arch or with a whorl pattern on the corresponding digit of the left hand. Thus $58.15\% - 11.28\% = 46.87\%$ of the loops in digit II of the right hand should meet with a loop in digit II of the left hand; in other words, the percentage of symmetry for loops on digit II of Javanese males should be 46.87. By counting the actual symmetry proved to be 47.0%.

If we now carry on the same calculation based on the percentile occurrence of loops in the left digit II we should as a matter of course find the same percentage of symmetry. Doing this, we find a percentage of symmetry of 47.81%. It is clear that the actual percentage of 47% agrees closely with those calculated theoretically. That the three values do not quite agree indubitably must be caused by the standard deviation, which plays an important rôle. In the first place it has an influence on the frequencies of the various patterns on the individual digits and as a consequence on their products, the cf values. It has an influence also on the af values. Further, the af–cf value is influenced by it and therefore also its mean value. So all the values used for the calculation above are not quite reliable. If notwithstanding this the theoretically calculated values and those actually found agree as well as they proved to do, this may be considered as a strong argument for the justness of the analysis given above.

Because of the importance of the close agreement between the percentages of symmetry found by counting and by theoretical calculation, I may add another example, whorls and arches in digit II of Javanese males. The actual symmetry proved to be 26.0% for whorls. Basing our calcula-

tion on the percentile occurrence of whorls on digit II of the right hand, the theoretically calculated symmetry was 26.04%. Based on the percentile occurrence of whorls in the left digit II this value proved to be 26.77%. For arches we found an actual symmetry of 2.42%, whereas the theoretically calculated values were 2.55% and 2.35%. It is clear that here there is even a closer agreement between the various values than in the case of loops.

SUMMARY

An investigation was made concerning the occurrence of symmetrical and asymmetrical combinations of papillary patterns in 2600 Javanese males, 2400 Javanese females and 900 Chinese males. Symmetrical combinations are those in which patterns of the same type occur on a pair of corresponding digits of right and left hands of an individual. Asymmetrical combinations are those in which the patterns are of different types. Radial and ulnar loops are considered as belonging to the same group of patterns. The frequency of each combination (actual frequency, abbreviated to af) was compared with the calculated value of this combination on the assumption of its determination solely by chance (chance frequency, abbreviated cf).

The conclusions previously made by Dankmeijer and the author concerning symmetrical occurrence of papillary patterns have all been confirmed.

Concerning the asymmetrical combinations the author arrived at the following conclusions:

1. For asymmetrical combinations the af value is always lower than the cf value. So there is no tendency to asymmetrical occurrence of papillary patterns, but on the contrary a tendency to repulsion between patterns of different type.

2. The intensity of this tendency varies among the three asymmetrical combinations. It is strongest for the arch-whorl combinations, weaker for the loop-whorl combinations, and weakest for loop-arch combinations.

3. For each of the asymmetrical combinations the tendency to repulsion has a constant value; this value is not influenced by race and sex.

4. By means of the constant values of the af–cf ratio, it is possible to calculate the frequencies of the asymmetrical combinations when percentile occurrences of the three patterns in individual digits are known.

5. The phenomenon of symmetrical occurrence of finger patterns is not primary but has to be considered as a consequence of the tendency to repulsion between patterns of different type.

6. It is possible to calculate the frequencies of the symmetrical combinations when the percentile occurrences of the three pattern types in individual digits are known.

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POLL, H. 1914 Ueber Zwillingsforschung als Hilfsmittel menschlicher Erbkunde. Zeitschr. f. Ethnol., vol. 46, pp. 87–105.

THE UNIQUENESS OF THE INDIVIDUAL.— Perhaps few physical anthropologists are aware that they might contribute to the solution of a problem of proof which exists in one of the applied aspects of their field, personal identification. It is axiomatic that no two individuals are exactly alike in physical traits but, as will be illustrated by reference to finger prints, difficulties arise in assembling and stating the evidences of truth of the axiom.

Cards bearing ten-digit sets of finger prints are classified and systematically filed in accord with major characteristics of the patterns. Prints of single digits likewise may be classified and filed on the basis of finer details. Identification of an individual may be quickly established, if he has a prior record, by classifying his prints and searching the corresponding section of the file for the one record in which the unclassified detailed features agree.

The problem of the uniqueness of the individual reaches its crux when there is available only an isolated finger print or a portion of one, as in the case of a chance print discovered at the scene of crime. It is a serious problem since under some circumstances criminal guilt may be proved by the identification of this print. Let us assume that such a print is found to agree in all detail with the digital impression of a certain person. The agreement is universally accepted as evidence that both prints were made by the same individual.

The axiom, "Nature never repeats exactly," has been invoked as ground for the conclusion that no two fingers bear identical patterns. There is substantial support for the truth of this axiom as it applies to finger prints. Despite search through many years no case of such correspondence has been discovered, even in single-ovum twins. However, each finger can not be compared with every other one, even in the existing universe of fingers, and final proof of the axiom is unattainable. Some writers on the subject have offered calculations, as a supplement to the feasible observations, showing that on the basis of chance the possibility of duplication may be disregarded. Unfortunately, this argument may give rise to the mistaken notion that the reference to chance means that in accord with the law of random events a duplication is inevitable, however rarely it might occur.

One writer (G. T. Mairs, in Finger Print Magazine, Nov., '45) refers to an "intuitive belief" that there can be no duplication. He continues, "why cannot an effort be made to work out a non-mathematical formula or line of reasoning, in layman's language, and using known biological facts, to confirm the faith that is in us?" A recent attempt to present a combination of the biological and mathematical reasoning (Chapter 8, in H. Cummins, and C. Midlo, *Finger Prints, Palms and Soles,* 1943, The Blakiston Company) apparently was not successful, at least from the standpoint of the practical fingerprint men who desire to have a simple formula of authority. The needed formula must be founded on facts, not intuitive belief or nonprobative assertions; it must be simply and succintly drafted, with a view to use as a source of testimony in the courts.— Harold Cummins, Tulane University.

THE SIGNIFICANCE OF THE PREMAXILLARY DIASTEMA IN PITHECANTHROPUS ROBUSTUS (SKULL IV)

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In a paper published in this journal (Montagu, '43) I wrote:

The fact that Pithecanthropus IV was characterized by a large premaxillary space whereas Sinanthropus has no space at all . . . would certainly separate these two forms into, at least, two distinct genera, and certainly renders Weidenreich's statement that "the differences are not greater than those found among the different races of present mankind" quite unacceptable.

In his recent study on Giant Early Man, Weidenreich ('45) comments upon this passage as follows:

When Ashley-Montagu wrote this sentence, he was apparently completely unaware that in the preceding pages of the same paper he himself noted the absence of maxillary diastema in the adult female orang-utan in three of 20 cases or in 15%.[1] Selenka (1898) found maxillary diastemas less than 1 mm broad in 4% of the adult males. Since only absence or presence of the maxillary diastema is considered by Ashley-Montagu as a sufficient distinction to assign two specimens to two different genera, I wonder why he did not split Pongo pygmaeus or, at least, the Pongo females into two different

[1] I am afraid that I am compelled to repudiate the suggestion that I wrote the paper referred to in a state of somnambulism. May I take this opportunity of assuring Dr. Weidenreich that I was fully aware of the significance of the data which I had gathered.

genera.[2] We know from Remane's interpretation that the breadth of the maxillary diastema varies from 16 mm to 1–2 mm in male gorillas, from 11 mm to nil in male orang-utans, from 11 mm to 1–2 mm in male chimpanzees, and from 6 mm to nil in gibbons. Maxillary diastemas one or more millimeters wide occur even in modern man.[3]

Since the issues raised by Weidenreich in this paragraph are both interesting and important, I should like briefly to discuss them further here.[4]

We now have the remains of at least half-a-dozen undoubted Pithecanthropus skulls. In only one of these, Pithecanthropus robustus (Skull IV), the most primitive of all on the basis of its cranial features as described by Weidenreich ('45), do we have the remains of the maxilla. This shows a premaxillary diastema of 6.2 mm on the left side and 5.0 mm on the right side. Now, the point is — and I would wish the reader to mark this long statement well — that the morphological importance of this fact is that, on the basis of our knowledge of the character of the premaxillary diastema in fossil and living anthropomorpha, we can say with certainty (or a high degree of probability — which is the same thing) that a diastema of such a size in a single recovered individual in which the maxilla was present indicates that a premaxillary diastema was characteristic of the group as a whole to which that particular individual belonged. That no matter how variable the size of the diastema, and there can be little doubt that it was very variable, such a diastema existed in by far the larger number of individuals comprising the group (I use the

[2] I stated, in what I thought was plain English, that "The adult apes, with the sole exception of some female orangs, all show the presence of larger or smaller premaxillary diastemata. In the case of the female orang we may look upon the occasional occurrence of non-diastematization as the expression of a purely sexual difference; the genus as a whole is characterized by the presence of appreciable diastemata" (Montagu, '43, p. 349). It is not the presence or absence of the diastema in an individual which is of importance but whether the diastema is present in the group as a whole or not.

[3] True; but relatively infrequently, and rarely more than one or two millimeters in size.

[4] See also Weidenreich's reply on p. 199 of this issue (Ed.).

term "group" here in a non-committal sense, without, for the present, making any judgment on the exact taxonomic position of Pithecanthropus robustus).

It is possible to make such a positive statement for the very good reason that a diastema of such a size is never found in any group of primates, and particularly in the anthropomorpha, unless it is a trait common to the group as a whole. This fact has been abundantly demonstrated in the studies of Remane ('21) and myself (Montagu, '35, '43). It is not the fact that the premaxillary diastema may be absent in a small percentage of the members of primate groups that is for our purposes of importance, but the fact that in such groups *presence* of the diastema is the general rule. In those groups in which absence is the general rule, as in the Hominidae generally, a premaxillary diastema of any size is of the very rarest exception.[5] Therefore, when such a diastema is encountered in the only known maxilla of a particular form, in the present case, Pithecanthropus robustus (Weidenreich), the obvious inference to draw on the basis of the known comparative evidence for other primate groups is that that trait was peculiar to the group as a whole of which that specimen was a biological member. Furthermore, since such a diastema does not occur in any of the known Sinanthropus skulls, the conclusion is clear that Pithecanthropus robustus and Sinanthropus pekinensis are forms of fossil man which, on the basis of this one trait alone, belong to two different groups. Weidenreich now believes Pithecanthropus robustus to be a more primitive form than Pithecanthropus erectus, and says that his "equating of Pithecanthropus and Sinanthropus referred to, and still refers, only to Pithecanthropus erectus (Skulls I and II). Although Pithecanthropus robustus is more primitive than Sinanthropus, a characterization which is not based solely on the existence of one indefinite feature (diastema), but on several others, I consider the differences not fundamental enough to separate the two forms "gen-

[5] The words "any size" are used here in the idiomatic sense of "appreciable," say anything beyond two or three millimeters, in the present instance.

erically'' from each other in the sense of the taxonomists and geneticists'' (Weidenreich, '45, p. 116).

Now, the question whether Pithecanthropus robustus differs ''generically'' from Sinanthropus can only be determined by the valuation which we give to the differences which are known to exist between them. For the purposes of the present discussion I am concerned here only with the value which may be attached to the premaxillary diastema as a specific or generic character. The evidence upon this point, within the framework of traditional taxonomic procedure, is conclusive. A survey and analysis of the facts as they exist among the groups, extinct and living, of the Order Primates shows that the premaxillary diastema never occurs in any group, either quantitatively or qualitatively, which is genetically as closely related to a group which does not possess such a diastema, as are, to quote Weidenreich, ''the different races of present mankind.'' Either the group is characterized by such a diastema or it is not. There is a definite disjunction, and as matters stand at present such groups happen to fall into different genera, not to mention families. This is the more significant since these classifications were not made upon the basis of the absence or presence of the premaxillary diastema, in most cases it was not even considered. The fact turns out to be that any group of primates which does not possess a premaxillary diastema differs morphologically very appreciably from any other group which does. The obverse is not true, namely, that any group which does possess a premaxillary diastema does not differ very appreciably from any other group which does. As a diagnostic character the premaxillary diastema is of value only in the sense of group presence or absence. In the Hominidae the diastema is absent, in the monkeys and apes it is present, while in the extinct genera of Australopithecine apes it was absent. Thus far presence or absence of the diastema has followed clear-cut lines, a fact which ordinarily endows such a character with fairly appreciable taxonomic value. In order that our classificatory systems should remain vital aids to the elucidation

of the significant genetic relationships existing between the groups comprising the Order of mammals in which we are interested it is desirable that significant differences be recognized when they occur. I believe that the presence or absence of the premaxillary diastema in any group (not in any individual, for our purposes) represents such a significant difference. In itself it may not be a character of generic value, but in point of fact it has always been associated with other morphologic characters which together have been considered of generic value. This does not, however, mean that the premaxillary diastema must remain a character of generic value. At the present time it serves as an indicator of probable or possible genetic difference. With the increase in our knowledge of the early Hominidae it may assume subgeneric, specific or even subspecific value. And this seems to be what is happening. Pithecanthropus robustus, on the basis of cranial characters alone, is either specifically or subspecifically different from Pithecanthropus erectus. Pithecanthropus erectus is either specifically or subspecifically different from Sinanthropus pekinensis, but not generically different. But Pithecanthropus robustus is morphologically appreciably more primitive a form than either of the former, and certainly stands further removed from Sinanthropus than does Pithecanthropus erectus. The differences are substantial, much more so than I knew when I stressed the important difference, as exhibited in the premaxillary diastema, between Pithecanthropus robustus and Sinanthropus.

Weidenreich goes on to say that he "would not be surprised if, one day, we were to encounter a Pithecanthropus maxilla without a diastema which may fit, in size and form, the Pithecanthropus Skulls I and II ('45, p. 116). Upon an earlier page, in conformity with this view, Weidenreich makes "the tacit assumption that the maxilla of Pithecanthropus Skulls I and II may not have differed basically from that of Sinanthropus ('45, p. 26).

This is a reasonable enough assumption with which, I think, most workers would agree. Since Pithecanthropus erectus

and Sinanthropus are morphologically so much alike the expectation would be that a premaxillary diastema would be wanting in the former as in the latter. Further finds, however, may tell conclusively.

There can, however, be little doubt that were we to find a fair number of Pithecanthropus robustus maxillae that an appreciable premaxillary diastema would be found present in most cases, if not in all.

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FIRST AMERICAN ANTHROPOMETRIC INSTRUMENTS.— In a letter inserted ahead of the Preface in his book *Crania Americana*, published in 1839, Samuel G. Morton acknowledges his indebtedness to John S. Phillips of Philadelphia for his ingenuity in supplying "the means of obtaining the elaborate measurements appended. . ." Toward the end of Morton's book (pp. 253, 294) it appears that Phillips devised the graduated cylinder used in the determination of cranial capacity, the apparatus that made possible the measurement of the capacity of different parts of the cranial cavity, and the "craniograph" that enabled Morton to make the original drawings for the illustrations.

Another friend, Dr. Turnpenny, also of Philadelphia, is credited with the original idea for the facial goniometer by which Morton determined the facial angle of Camper. This instrument, slightly improved by Broca, was manufactured by Mathieu in Paris.

It seems probable that these ingenious devices were the first American contributions to the now extensive list of anthropometric instruments.

MAXILLARY DIASTEMA AS A CRITERION OF GENERIC DISTINCTION

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The issue in the controversy between Ashley Montagu and me [1] is the question whether the occurrence of a maxillary diastema in one specimen of an anthropoid or hominid group sufficiently justifies the placing of the form concerned in a category, either genus or species, differing from another form in which such a diastema has not been observed.

To come closer to the point, the maxilla of Pithecanthropus Skull IV exhibits a wide diastema. Ashley Montagu, who had no further knowledge of the morphological peculiarities of this skull at the time he wrote his first article, considers this one feature alone decisive enough to separate Pithecanthropus generically from Sinanthropus, because so far no maxillary diastema has been found in the latter. I objected to this kind of reasoning and referred to his inconsistency in emphasizing first that the diastema may or may not occur in orang-utan and then failing to apply his own principle of the diagnostic value of the diastema to the classification of the orang-utan itself. Nor am I able to accept Ashley Montagu's suggestion, which he brings forward now, that "the non-diastematization (in orang-utan) is the expression of a purely sexual difference," for this may be the case also in Pithecanthropus, because the diastema has been found so far only in the maxilla of an obviously male individual. To attribute presence or absence of the diastema to sexual differences in orang-utan but to generic differences in hominids makes no

[1] See paper by Montagu on p. 193 of this issue.

sense to me. Neither does the whole artful discrimination between presence or absence in the diagnostic valuation of the feature. In any case it is a quite arbitrary judgment, no matter whether it is called inconsistency or "somnambulism," a term apparently preferred by Ashley-Montagu.

In my recent paper on "Giant Early Man in Java and South Asia" I showed that Pithecanthropus robustus differs from Sinanthropus and the other representatives of Pithecanthropus (for which I kept the name "erectus") not only by the presence of the diastema but also by other characteristic features in the dentition, facial bones (palate) and certain structures of the brain-case. This is the real reason why I regard Pithecanthropus Skull IV as another type than Skulls I and II. Ashley Montagu speaks of "at least half-a-dozen undoubted Pithecanthropus skulls." Leaving it undecided whether this statement should be characterized as carelessness or "somnambulism," it is in any case a misleading exaggeration. So far, I know of only four incomplete skulls. Of these, Skull III must be excluded because it represents a young child and consists only of fragmentary parietal and occipital bones. Of Skull I only the cap is preserved and of Skull II, the greater part of the braincase but no facial bones have been found. Therefore, Skull IV is the only one with a maxilla and a diastema. Considering the great variability in the occurrence and development of the maxillary diastema in anthropoids, as admitted by Ashley Montagu, it is certainly hazardous to proclaim the occurrence of this feature, and only this, as evidence that the entire Pithecanthropus group represents a distinct and separate genus of hominids.

A similar incident which occurred in regard to Sinanthropus warns one to be cautious. When the first skull was discovered, Davidson Black found a split in the tympanic bones on both sides and was inclined to regard this peculiarity as a typical feature of Sinanthropus. However, all the temporal bones discovered subsequently do not show split tympanic bones; therefore the presence of the split in the tympanic cannot be

used as a criterion for a generic or specific distinction between Sinanthropus and other hominid forms.

As I have stated repeatedly, I consider the generic or specific significance of the latinized names given to the various fossil hominids as completely irrelevant, at least in the present state of our knowledge. When I resorted to those names or mentioned them, I did this only in order to signalize morphological differences judged indicative of phylogenetic evolution. It is my intention to continue this practice because I vigorously object to any attempt to enlarge these differences by mere nomenclatorial tricks. On the contrary, we must simplify the human pedigree as far as is compatible with the morphological data at hand. We should not complicate the problem by morphologically unfounded presumptions, lest the leading line of evolution be lost and nothing left but singular forlorn specimens with which nobody can work.

Blood Groups of Closely Related Peoples.— We have not been able to demonstrate any differences between the M N distribution in Norway and Germany, where one of us previously has shown that remarkable differences were present with regard to the blood group distribution within the O A B system. Further we have proved a considerable difference between the distribution in Norway and Sweden, where one of us recently has recorded a comparatively minor difference in the O A B distribution. Between Norway and Finland great differences exist as well after the M N as the O A B system.

From this we can conclude that in some cases one may expect to find greater differences after the M N system than after the O A B system in closely related peoples; or in other words, in some cases the M N distribution may give more information than the O A B distribution about serological differences between human populations. It must therefore be useful to employ both the O A B distribution and the M N distribution in the performance of such investigations. — Otto Hartmann and Jon Utheim Lundevall. Blood group distribution in Norway. Avh. Norske Vidensk.-Akad., I. Mat.-Nat. Kl., 1944 (1945), 68 pp.

Cause of Osteoporosis.— Hyperthyroidism in the presence of insufficient calcium and phosphorus intake often produces definite osteoporosis which may be detected roentgenologically. Severe cases of osteoporosis may lead to osteomalacia and spontaneous fractures. Gross deformities and dwarfism may result.— I. Darin Puppel et al. Rationale of calcium, phosphorus and vitamin D therapy in clinical hyperthyroidism. Surg., Gyn. and Obs., vol. 81, 1945, pp. 243–265.

Effects of Exercise on Knee Joints.— Continued daily use of joints . . . did not contribute to the incidence and severity of joint degeneration in mice, and perhaps it prevented or delayed the appearance of early changes. The explanation for these results is not apparent.

The experiment adds support to the conclusions of Key, the Silberbergs, and others, that mechanical factors are subordinate in the production of degenerative joint lesions. The metabolic processes of ageing cartilage must be comprehended, as suggested by Bennett, Waine, and Bauer, if the problem is to be solved.

The insertion of the patellar ligament into the tibia could be clearly demonstrated in all but one of the knees examined. . . . In twenty-three joints there was marked bone formation at that point, deposited in roughened tubercles often having marrow cavities and cyst-like areas filled with degenerate fibrous tissue. These changes were found in fourteen exercised and nine control joints. There is . . . a lack of statistical significance in the occurrence of ossification of the patellar ligament in workers and non-workers. The largest amount of ossification was found in a control.

These findings support the statements of Todd, that crests and tubercles marking the attachments of muscles and tendons to the skeleton are age changes and have no relationship to muscular activity. Anatomists and physical anthropologists have frequently taken prominent crests, tubercles, and ridging in skeletal remains of unknown origin to indicate vigorous muscular development. In the mice observed it appears certain that exercise is not related to the formation of the tuberosity at the attachment of the patellar ligament.— Raymond R. Lanier. The effects of exercise on the knee-joints of inbred mice. Anat. Rec., vol. 94, no. 3, 1946, pp. 311–319.

ON THE INCIDENCE OF THE FORAMEN OF CIVININI AND THE PORUS CROTAPHITICO-BUCCINATORIUS IN AMERICAN WHITES AND NEGROES

I. OBSERVATIONS ON 1544 SKULLS

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ONE TEXT FIGURE AND ONE PLATE (FIVE FIGURES)

INTRODUCTION

A particular spine of the sphenoid bone, now known by Civinini's name was first described by him in 1829. In 1837 Civinini described a foramen formed by an extension of this spine. Hyrtl in 1862 designated another opening in the same region, the porus crotaphitico-buccinatorius. The foramen of Civinini and the porus crotaphitico-buccinatorius are confused in the literature to the extent that one has been mistaken for the other. Dr. R. J. Terry of Washington University, Saint Louis, suggested the present study to determine the incidence of the foramen of Civinini and of the porus crotaphitico-buccinatorius and to attempt to clarify the confusion in the literature. Dr. George A. Seib, under Dr. Terry's direction, in an unpublished study investigated the relations of this region in the dissecting room material. The present study on the macerated skulls in the Washington University collection was begun with Dr. Seib's permission.

The pterygo-spinous foramen of Civinini is formed by the ossification of a pterygospinous ligament. This ligament stretches from the angular spine of the sphenoid to the spine

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of Civinini situated at about the middle of the posterior border of the lateral pterygoid lamina of the same bone (fig. 1). When the ligament ossifies it completes the boundaries of the bony foramen (fig. 2). The size of this foramen varies not only in different skulls but on the two sides of the same skull. It may be one large foramen about 10 mm in diameter or it may be divided into as many as five distinctly separate foramina of various sizes. Usually, according to Hyrtl (1862) and others, nothing passes through this foramen. I have occasionally observed, however, that some vein or veins of the pterygoid plexus may pass through this foramen or its subdivisions. According to V. Brunn (1891), Grosse (1893), de Froe and Wagenaar ('35), and Terry ('42), the nerve to the internal pterygoid passes through it.

The porus crotaphitico-buccinatorius is formed by a bar of bone connecting the inferior surface of the great wing of the sphenoid to the lateral surface of the lateral pterygoid plate of the bone near its root. In the majority of cases this bar of bone lies lateral to the foramen ovale, in contrast to the bony bar completing the foramen of Civinini which most often lies either below or on the medial side of the foramen ovale. A number of branches of the third (mandibular) division of the trigeminal nerve pass through this porus. Among them are, the nerve to the buccinator muscle, the nerve to the lateral or external pterygoid muscle and a nerve or nerves to the temporal muscle. Sometimes the nerve to the masseter muscle may also pass through this foramen or canal. The above mentioned bar of bone may run beneath the foramen ovale, dividing it into two parts. This bar, especially when it is strong and heavy, forms the wall of a canal 2 to 5 mm long and makes the passage of a needle or any other instrument into the foramen ovale from the outside either difficult, or impossible (fig. 3). In such cases in a dry skull when viewed from below, it may be impossible to see the foramen ovale. If this bony bridge is narrow and thin it forms only a foramen or porus (fig. 4). Even in these cases passage of the needle to the foramen ovale would not be easy.

OBSERVATIONS

In the 1544 Negro and White skulls of the Terry Skeletal Collection at the Department of Anatomy of the Washington University, Medical School, St. Louis, Mo. the foramen of Civinini was found to be present 97 times, or in 6.28% of cases. The porus crotaphitico-buccinatorius was seen to be present 159 times, or in 10.30% of cases of the same collection.

These skulls are divided according to race and sex as follows: White males, 576; White females, 106; Negro males, 594; and Negro females, 268. The age varied from 16 to 101 years.

As Lanier ('44) has pointed out, the average age of the Whites is greater than that of the Negroes in the Terry Collection. The racial composition, and the method of preparation of the specimens have been described by Terry ('32) and Lanier ('40).

THE FORAMEN OF CIVININI

The foramen of Civinini was present three times more often in the skulls of the White males than in the skulls of the Negro males, 10.76% and 3.54% respectively. The presence of the foramen of Civinini in the White and the Negro females shows even a more striking difference, 10.38% and 1.12% respectively. The combined ratio of the foramen of all Whites, males and females, to all Negroes, males and females, is 10.70% to 2.78%. Data for the presence of the foramen of Civinini in the stocks, sexes, and sides are presented in table 1.

THE PORUS CROTAPHITICO-BUCCINATORIUS

The porus crotaphitico-buccinatorius of Hyrtl was found almost twice as often in the Negro skulls as in the White skulls. The ratio for the males was slightly more than 2 to 1, while in the females it was slightly less. Table 2 reveals the data for the presence of the porus crotaphitico-buccinatorius of the races, sexes, and sides.

The foramen of Civinini was found to be present at its earliest in a Negro male skull, 23 years, and in a 27-year-old White female skull. The oldest skulls showing the foramen of

TABLE 1

The foramen of Civinini.

NEGROES	SIDE	NO.	%	TOTAL %	WHITES	%	TOTAL %	TOTAL NOS.	%	
Males	Right	8	1.35	3.54	27	4.69	10.76	35	2.99	7.09
	Left	13	2.19		35	6.07		48	4.10	
	Bilateral	3			7					
Females	Right	3	1.12	1.12	3	2.83	10.38	6	1.60	3.74
	Left	0	0		8	7.55		8	2.14	
	Bilateral	0								
Total	Right	11	1.27	2.78	30	4.40	10.70	41	2.65	6.28
	Left	13	1.51		43	6.30		56	3.63	

TABLE 2

The porus crotaphitico-buccinatorius.

NEGROES	SIDE	NO.	%	TOTAL %	WHITES	%	TOTAL %	TOTAL NOS.	%	
Males	Right	44	7.41	14.98	18	3.13	7.47	62	5.30	11.28
	Left	45	7.57		25	4.34		70	5.98	
	Bilateral	19			5					
Females	Right	11	4.10	8.21	2	1.89	4.72	13	3.48	7.22
	Left	11	4.10		3	2.83		14	3.74	
	Bilateral	2			1					
Total	Right	55	6.38	12.88	20	2.93	7.04	75	4.86	10.30
	Left	56	6.50		28	4.11		84	5.44	

Civinini were those of an 86-year-old Negro male and an 88-year-old White female.

The youngest skull showing the porus crotaphitico-buccinatorius of Hyrtl in the Negro was a female of 16 years, in the White a female of 27. The oldest in the Negro was a male of 79 and in the White a male of 87.

Both of these anomalies, the foramen pterygo-spinosum of Civinini and the porus crotaphitico-buccinatorius were present bilaterally in a skull of a White male aged 60. In 6 other skulls of the White males they were present on the right side only. They were found on the left side only in 2 skulls of the White females, in 5 skulls of the White males, and in 3 skulls of the Negro males. In 2 skulls the foramen of Civinini was present on one side and the porus crotaphitico-buccinatorius on the other side.

The occurrence of the foramen of Civinini and the porus crotaphitico-buccinatorius according to age and sex, upon calculation is found not to be statistically significant. It can be stated that the porus crotaphitico-buccinatorius was present in the largest percentage of cases in the sixth decade and the second largest in the second decade in the Negro males. The third decade showed the presence of this anomaly in the smallest percentage of cases. From the third to the sixth decade there was a gradual but steady rise in the incidence of the presence of the porus crotaphitico-buccinatorius in this age group of Negro males, but there was a definite fall in the seventh decade.

In the Negro females the porus crotaphitico-buccinatorius was present in the highest percentage of cases in the second decade and the lowest in the fourth decade. There was no regularity of rise or fall in the presence of this anomaly in the other decades in this group.

In the White males the porus crotaphitico-buccinatorius of Hyrtl was found in the largest precentage of cases (10%) in the fifth decade and the smallest percentage (about 5%) of cases in the sixth decade. In all the other decades the per-

centage of cases showing this anomaly was somewhat irregular, but it was about 8% in all these irregular groups.

In the White females the porus crotaphitico-buccinatorius was present in the highest percentage of cases in the second decade of age group and the lowest in the seventh decade. There was no porus crotaphitico-buccinatorius observed in the third, fourth, sixth or eighth decades of this group.

The foramen of Civinini was present in the largest percentage (16.67) of cases in the eighth decade of age and in the smallest percentage (1.16) of cases in the sixth decade in the Negro males. The percentage of the presence of this anomaly was very irregular in the other decades of this group.

In the Negro females the highest and the lowest percentage of cases showing the presence of foramen of Civinini was found in the fifth and the third decades respectively. No foramina were observed in the second, sixth, seventh and eighth decades of this group at all.

In the White males the foramen of Civinini was present in the highest percentage of cases in the eighth decade of age (16.67%) and the lowest percentage of this anomaly was found in the fifth decade (8.57%). The percentage of presence of the foramen of Civinini was very irregular in the other decades. In other words there was no regular increase or decrease in the percentage of this anomaly in different decades.

The foramen of Civinini was seen in the highest percentage of cases in the second decade in the White females (40.00%) and the lowest in the sixth decade (6.90%). No foramina of Civinini were observed in the third and fourth decade at all. The presence of this anomaly in the other decades of this group did not show any definite trend of increase or decrease with any regularity.

DISSECTING ROOM MATERIAL

During the years 1931 to 1934 Dr. Seib recorded the frequency of what appeared to be the foramen of Civinini in 179 bodies in the anatomic laboratories of the Washington Uni-

versity. My examination of the skulls of this series, after maceration gave results at variance with those obtained before maceration. An incomplete foramen of Civinini can easily be mistaken for a true foramen in the dissecting room material. The examination of the cadaveric material for the presence or absence of either the foramen pterygospinosum

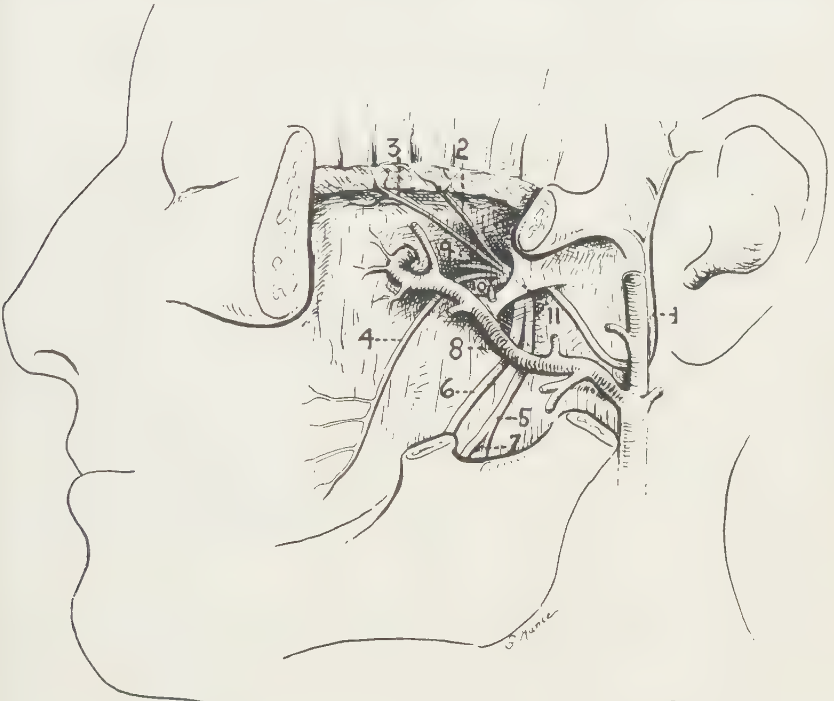

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Fig. 5 The pterygo-alar foramen (the porus crotaphitico-buccinatorius) from the dissecting room. The bridge of bone (11) bounds the porus out of which emerge nerves 2, 3, 4, 9, and 10. Nerves 1, 5, 6 emerge below bridge 11, which covers the exit (foramen ovale) of the parent trunk (mandibular n.) of all of the nerves shown here.

1. Auriculo-temporal n.
2. Post. deep temporal n.
3. Ant. deep temporal n.
4. Buccinator n.
5. Inf. alveolar n.
6. Lingual n.
7. Mylohyoid n.
8. Int. maxillary a.
9. N. to ext. pterygoid.
10. N. to masseter making
11. Bridge over porus cortaphitico-buccinatorius.

of Civinini or the porus crotaphitico-buccinatorius of Hyrtl must be checked on the macerated skull.

During the course of a routine dissection by medical students Dr. M. Trotter of the Washington University, St. Louis has recently found a specimen of the porus crotaphitico-buccinatorius of Hyrtl. She has kindly sent me the attached sketch (fig. 5) of the specimen with permission to include it in this paper. In the drawing the bridge of bone (11) bounds the porus crotaphitico-buccinatorius out of which emerge nerves 2, 3, 4, 9, and 10.

DISCUSSION

What factors are responsible for the presence of the foramen of Civinini and the porus crotaphitico-buccinatorius? Perhaps chewing on one side could cause the development of the bony bars in the fibers of the pterygoid muscles; just as rider's bones were claimed to develop in the tendons of adductor muscles of the thigh by excessive horse back riding. Even though no data are available as to the chewing habits of these individuals, it does not seem logical to expect such a bone formation by mastication. If the bones did develop in the muscle under such conditions their position would be expected to be in the muscle tendon rather than between the two parts of sphenoid bone.

Some thought was given as to whether infection might possibly result in such a bone formation. Pathological bone formations are usually irregular in contour, while the bony bars completing the foramen of Civinini or porus crotaphitico-buccinatorius are more or less smooth. Furthermore no gross pathological bony lesions were observed in or around the areas of the location of these anomalies. These findings seem to prelcude infection as a cause of such bone formation. Perhaps their presence may be said to be atavistic, for the porus crotaphitico-buccinatorius is more or less generally present in higher apes, but that is only a speculation.

Hyrtl (1862) describes the porus crotaphitico-buccinatorius as a hole or a canal on the lower surface of the base of the

great wing of the sphenoid into which the ramus crotaphitico-buccinatorius of the third division of the trigeminal nerve enters immediately after its separation from the mandibular division, to divide past that location into the rami temporalis anterior and posterior, buccinatorio-labialis and pterygoideus externus. In one of his dissections he found the canal traversed also by the ramus massetericus. This abnormal porus may be confused with the foramen ovale or the foramen pterygospinosum.

Before its division, the nervus crotaphitico-buccinatorius clings to that portion of the base of the great wing of the spenoid which lies in front of the foramen ovale and lateral to the base of the pterygoid process. In its apposition to the bone, in many dissections this nerve lies in a shallow but broad sulcus; when this sulcus is bridged by a bony process, a hole or a short canal is formed. The direction of this short canal is oblique, starting from the foramen ovale forward and outward toward the crista alae magnae, or crista infratemporalis alae magnae (Henle). The hole or the anterior opening of the short canal is seen by looking obliquely into the deepest part of the spheno-maxillary fossa from in front. The width of the canal does not vary as much as that of the foramen ovale.

The porus crotaphitico-buccinatorius, often only a furrow, may be either at the base of the angular spine, or on that of the pterygoid process, formed through the projection of processes, in the first location directed forward, in the latter backward and outward. If both processes are present at the same time the formation of the foramen is most distinct.

Hyrtl states that neither Henle discussing variations of the foramen spinosum nor Schwegel discussing variations of the region of the infratemporal crest of the sphenoid could have meant his porus crotaphitico-buccinatorius since their respective descriptions refer to different locations. According to him the porus crotaphitico-buccinatorius can hardly be confused with those foramina which are occasionally formed by the union of the long and wide protrusions of the posterior margin of the external pterygoid lamina with the spina angularis of

the sphenoid. As a remote possibility, Hyrtl thought that the appendix-like connection between the pterygoid process and the spina angularis might impress the casual observer as the boundary of the porus crotaphitico-buccinatorius. However, he says, all these strap-like fusions between the pterygoid process and the spina angularis always produce holes which never serve for the passage of any structures, never become short canals and are generally too large for the porus described by him. Also their planes are vertical, just as is the pterygoid process itself. Many years ago Civinini mentioned fibrous strands connecting the pterygoid process with the spina angularis which occasionally may become ossified and result in a bony bridge. To furnish further proof for the entirely different character of his porus and the foramina of Civinini Hyrtl demonstrated the simultaneous occurrence of both structures (the porus crotaphitico-buccinatorius and the foramina of Civinini) in the skull of a Nubian from Darfur. The porus crotaphitico-buccinatorius, Hyrtl continues, always lies lateral to the foramen ovale, the Civinini foramina, formed by ossification of the pterygo-spinous ligament, either lie medial to the foramen ovale or below it, so that they are in the same or nearly the same cephalo-caudal plane with the foramen ovale. Hyrtl (1862) found four cases of a complete porus crotaphitico-buccinatorius in 600 cases or about 0.67%.

Civinini (1837), quoted by Von Brunn (1891), pointed out that a normally present band, ligamentum pterygo-spinosum, running across from the posterior border of the lateral lamina of the pterygoid process to the angular spine of the sphenoid bone is occasionally replaced by a bony bridge. According to Civinini on the lateral side of this ligament lie the middle meningeal artery, the branches of the inferior alveolar and lingual nerves and the bend of the internal maxillary artery on its way to the external pterygoid muscle. On its ossification, as mentioned above, the bony bridge lies together with the upper part of the original ligament on the posterior margin of the pterygoid process. As a result of the ossification of the pterygo-spinous ligament one finds a large round opening,

foramen pterygo-spinosum, between the lateral pterygoid lamina and the angular spine of the sphenoid, completed by the inferior surface of the great wing of the sphenoid. It stands in the plane of the lateral pterygoid lamina.

Von Brunn (1891) gives the description of the foramen pterygo-spinosum of Civinini and porus crotaphitico-buccinatorius of Hyrtl as given by the original authors. He examined 406 skulls, 236 from his own collection and 170 from other sources. Twenty-one of these (5.17%) showed the foramen pterygo-spinosum of Civinini; in three of them it was present on both sides. In his figure 1 the foramen pterygo-spinosum of Civinini is large, 10 mm in diameter, but the bony plate completing it is thin. In other cases (figs. 2 and 5) it is small, only 2 to 4 mm wide, round or oval, its wall is thick and it lies under the foramen ovale. He says: "Bemerken möchte ich hierzu noch, dasz man die völlige Ausbildung der Knochenspangen nicht etwa als ein Vorrecht höheren Alters betrachten darf; Fig. 1 ist nach dem Schädel eines 12-jährigen Mädchens gezeichnet." He found a complete porus crotaphitico- buccinatorius of Hyrtl in 7 out of 406 skulls (1.72%), in 2 of these on both sides. He believes that the formation of both the foramen pterygo-spinosum of Civinini and porus crotaphitico-buccinatorius of Hyrtl in the human skull is atavistic in nature.

Grosse (1893) found the foramen of Civinini 14 times in 600 skulls of his anatomic collection (2.33%), in 1 of these it was present on both sides. A spine was distinctly visible in 60 skulls. In the same collection he found the porus crotaphitico-buccinatorius of Hyrtl in 8 skulls (1.33%) and in 3 of these it was present on both sides. In 42 additional cases one or two bony points were indicated. In 400 skulls of "der Sammlung der Physikalisch-ökonomischen Gesellschaft" he found the foramen of Civinini in 3% and indicated in 20%, that is, two bony points were definite. The porus crotaphitico-buccinatorius of Hyrtl was formed in 1.5%, and in 5% one or two bony points were clearly visible. He does not give the race or sex of these individuals.

The description of the location of the foramen of Civinini and the porus crotaphitico-buccinatorius of Hyrtl given by Grosse is confusing. He states: "Das Loch, welches v. Brunn For. pterygo-spinosum nennt, ist der mediale Teil der unteren Oeffnung jenes Kanals, der durch die knöcherne Verbindung der Lamina pteryg. lat. mit der Spina angularis zwischen grossem Keilbeinflügel und lateraler Pterygoidlamelle zu-Stande kommt. Der laterale Teil dieser Oeffnung is das For. crotaphiticum, der mediale das For. pterygo-sphenoideum."

Grosse (1893), discussing the literature, states that all cases mentioned by Krause showed approximately 7% of the ligaments ossified to complete the foramen of Civinini, but according to Grosse, Krause did not mention Civinini's name.

According to Grosse, V. Brunn commits the error of saying that the foramen of Civinini is the same as the lower opening of the canal through which the sensory part of the third division of the trigeminal nerve passes downward. However, Grosse states that the foramen of Civinini is an opening in the posterior wall of this canal and the foramen pterygo-spinosum of v. Brunn is the same as Grosse's foramen pterygo-sphenoideum, that is below the opening of that canal.

Grosse questions the statement of Hyrtl to the effect that nothing passes through the foramen of Civinini. According to Grosse a small nerve to the internal pterygoid passes through this foramen. He states that in 1840 Faesebeck called this opening (Foramen of Civinini) the foramen interruptum.

Grosse concludes that in the human skull there exists a ligament that extends from the lateral pterygoid lamina to the angular spine of the sphenoid. This band (ligamentum pterygo-spinosum) separates the third division of the trigeminal nerve from "the muscle and the Eustachian tube." Above the position of origin of this ligament from the external lamina lies a smooth notch, incisura of Civinini, through which passes the nerve to the internal pterygoid muscle. This ligament can ossify either partially or completely. When ossified completely it forms a hole, the foramen of Civinini. The higher apes have an incisura Civinini and a ligamentum pterygo-spinosum. In

the lower apes a bony foramen of Civinini is constantly present. Grosse did not find a foramen of Civinini in any other mammal.

Concerning the porus crotaphitico-buccinatorius of Hyrtl, Grosse concludes that in man as in all mammals one frequently finds a sulcus on the inferior surface of the great wing of the sphenoid bone running antero-laterally, called sulcus crotaphiticus. This sulcus is always bridged over by a ligamentous band, which separates the motor from the sensory part of the third division of the trigeminal nerve. Sometimes in man and in higher apes this band ossifies. In the other apes and in rodents it is always limited by bone and the foramen crotaphiticum is present.

Quain (1878) in his "Elements of Anatomy" 8th edition has described a connection between the angular spine and the external pterygoid lamina as follows: "The outer pterygoid plate may be connected by a bridge of bone or of ligament with the spinous process." In the German edition of Hoffmann-Rauber (1878) it is inaccurately translated: "Die Lamina pteryg. ext. erstreckt sich schräg nach aussen und hinten, ist sehr breit und öfters mit dem Griffelfortsatze durch ein Knochenplättchen verbunden."

In the newer edition of Quain's Anatomy (1893) the ligament is described as previously, with the addition of the words "(pterygo-spinous)" but the name Civinini is not added.

E. Roth (1883), quoted by Grosse (1893), after examination of the skulls from a variety of the representative stocks of people, arrived at the conclusion that in the "niederen Menschenrassen" a bony connection of the external lamina of the pterygoid process with the great wing of the sphenoid exists more frequently than in the "höheren Rassen." From this he inferred that the above mentioned osseous union could be considered an animal resemblance. This inference especially supports his finding that in the majority of apes a bony union is always present between the external lamina of the pterygoid process and the great wing of the sphenoid bone. Grosse's

investigations in general agree with these conclusions and inferences of Roth.

The bony bridge formed through the ossification of the ligamentum pterygo-spinosum says Grosse (1893), serves chiefly for the attachment of muscle. The other connection formed by bridging over the sulcus crotaphiticus, became known first through Hyrtl as porus crotaphitico-buccinatorius. This bony bar separated the motor fibers of the third division of the trigeminal nerve from the sensory fibers. It is wrong to designate the two bony connections as the ossification of a single ligamentum pterygo-spinosum. The ligamentum pterygospinosum of Civinini stretches between the external lamina of the pterygoid process and the angular spine, while the other fibrous structure of the ligamentum pterygosphenoideum runs from the external lamina of the pterygoid process to the anterior margin of the foramen ovale. According to Grosse, Roth does not keep the foramen of Civinini and the foramen crotaphiticum of Hyrtl separate.

Oetteking ('30) states that: "Between the spina angularis and the spina Civinini of the external pterygoid plate, . . . the ligamentum pterygospinosum, extends in the living. It is to the successive stages of ossification that the variations of the foramen Civinini are due." His article shows drawings of incomplete, almost complete, and a true foramen pterygospinosum (Civinini). He found 26 perfect or complete foramina in 467 skulls examined or 5.57%, compared to my findings of 97 foramina in 1544 skulls or 6.28%.

Martin ('28) gives the frequency of the foramen of Civinini in the Europeans as 4.8% complete, and 18.3% incomplete. For the non-European races his figures are 15% to 33%. According to him the formation of this foramen is normal in the majority of primates.

Jones ('31) states: "In Man the condition of the spina angularis varies widely . . . and it may be, with varying degrees of completeness, connected with the lamina lateralis of the pterygoid process." He goes on further: "In Man and the anthropoids the pterygo-spinous bar is usually not com-

plete. When it is present in varying degrees of completion it gives rise to that group of anomalies in which the foramen of Civini (sic) and the porus crotaphiticobuccinatorius of Hyrtl are included.''

In a series of 100 Hawaiian skulls Jones ('31) found that: ''In 8 per cent. an attempt at the completion of a pterygo-spinous bar was present, this occurred equally frequently on the right and left sides but in no case was bilateral. In every case the bar passed medial to the foramen ovale.''

In 92 skulls of prehistoric inhabitants of Guam, the same author found: ''The tendency to the formation of a pterygo-spinous bar is displayed only in a manifestation to develop a ridge to the medial side of the foramen ovale.''

Describing the spina angularis sphenoidei in 94 male and 58 female Australian skulls Krogman ('32) mentions that: ''In 2 per cent. of the male skulls it was of such length that, curved slightly laterally, it merged with the lower margin of a very large lateral pterygoid lamina.''

Studying the laminae pterygoidei in 89 male and 58 female skulls he states that: ''As previously noted, there was a tendency for the tip of the lateral lamina to contact with the tip of the spina angularis, and when such a pterygo-spinous bar was complete it passed medial to the foramen ovale.''

In my investigation of 1544 skulls of American Negroes and Whites it was found that the bony connection between the lateral lamina of the pterygoid process and the under surface of the great wing of the sphenoid is twice as frequent in the American Negroes as compared to the American Whites.

Piersol's Anatomy ('30) describes the foramen of Civinini and the porus crotaphitico-buccinatorius as follows: ''The development of the pterygoid plates varies greatly. The upper part of the outer may be prolonged to the spine of the sphenoid, just outside of the foramen ovale, with a perforation at this point, so that some of the branches of the third division of the fifth cranial nerve may pass on either side of it. This occurs by the ossification of a band of fibrous tissue, connecting the back of the plate with the spine, and thus forming

the foramen pterygo-spinosum of Civinini (fig. 212). This is always behind the foramen ovale, or internal to it. Just outside of the foramen is found, very rarely, a little canal on the under side of the great wing, transmitting a branch of the mandibular division of the fifth nerve, the porus crotaphitico-buccinatorius of Hyrtl.'' The frequency of occurrence of these foramina is not given.

Gray's Anatomy ('42) describes the pterygospinous ligament, without referring to Civinini, as follows: ''The pterygospinous ligament stretches from the upper part of the posterior border of the lateral pterygoid plate to the spinous process of the sphenoid. It occasionally ossifies, and in such cases, between its upper border and the base of the skull, a foramen is formed which transmits the branches of the mandibular nerve to the muscles of mastication.'' No figures for frequency or percentages are given.

Cunningham's Anatomy ('43) mentions them thus: ''. . . the pterygo-spinous foramen, enclosed by ossification of the band between the spine and the lateral pterygoid plate; the porus crotaphitico-buccinatorius, enclosed by ossification of a ligament below and lateral to the foramen ovale.'' No figures are given for frequency or percentages.

Terry ('42) gives the following description of the foramen of Civinini and the porus of Hyrtl: ''Foramina brought about by bridges of bone between the posterior margin of the lateral pterygoid plate and the angular spine (pterygospinous foramen of Civinini), transmitting the nerve of the internal pterygoid, and between the pterygospinous process and the great wing (porus crotaphitico-buccinatorius, for the lesser division of the mandibular nerve) are occasionally observed. The presence of these bridges in 6% of cases (De Froe and Wagenaar, Fortschr. a.d. Geb. d. Röntgenstr. 52: 64, '35) forms an obstruction to the introduction of instruments into the foramen ovale.''

de Froe and Wagenaar ('35) observed that in 5% of European skulls the pterygo-spinous ligament is entirely ossified to complete the foramen pterygospinosum of Civinini. They

state that through this foramen pass the nerves and blood vessels to the internal pterygoid muscle. According to them Fr. Haertel thought that the presence of such a foramen could hinder the injection of the semilunar ganglion for trigeminal neuralgia through the foramen ovale, but this cannot be true. The ligamentum crotaphitico-buccinatorium runs from the lateral surface of the lateral pterygoid lamina approximately in the antero-lateral direction in front of and near the foramen ovale to the under surface of the great wing of the sphenoid. In about 1–2% of cases one finds these ligaments completely ossified. Thereby a sagittally directed opening (Porus crotaphitico-buccinatorius) is formed through which the masticator nerve passes. The presence of such a porus can really make the injection of the semilunar ganglion impossible; even with an incompletely ossified ligament it is often impossible to go through the foramen ovale to the ganglion. According to Fr. Haertel it is impossible to succeed in 6% of cases. de Froe and Wagenaar ('35) believe that either due to the presence of the ossified ligamentum crotaphitico-buccinatorium or on account of the unfavorable axis of direction for the injection, or owing to the greater depth of the foramen ovale the injection would probably have failed to reach the semilunar ganglion in 6% of their cases. Roentgenological examination has made it possible for them to avoid injecting those cases that promise poor results.

de Froe and Wagenaar credit Haertel with the first success in showing the foramen ovale in the roentgenograms of the base of the skull. Götze also used roentgenological examinations with success. They describe Haertel's technique of the x-ray examination of foramen ovale and an improvement by Brücke. It is significant because it determines the safe direction of the injection needle to the foramen ovale.

Haertel thought, as mentioned above, that the presence of an ossified ligamentum pterygo-spinosum could be a reason for the failure of the puncture to reach the semilunar ganglion. The anatomical investigations of de Froe and Wagenaar as well as my own show that this is not the case, but that the

failure must require the presence of an ossified ligamentum crotaphitico-buccinatorium. The roentgen examination of the foramen ovale in the direction of the puncture has proved this point.

de Froe and Wagenaar reproduce the roentgenograms of the normal foramen ovale, foramen ovale adjacent to an osssified ligamentum pterygo-spinosum, another one next to a partially ossified ligamentum crotaphitico-buccinatorium, and still another one with a completely ossified ligament. The last one is so placed that it crosses over the foramen ovale so as to hinder a needle directed to the semilunar ganglion. In this case the injection through the foramen ovale would be very difficult. They show an additional roentgenogram of a completely ossified ligamentum crotaphitico-buccinatorium portraying the total blocking of access from the skin to the foramen ovale.

They conclude that the radiograph is not only significant for close determination of the direction of the puncture needle but also as a preliminary examination to establish whether the puncture passage is free. An ossified lig. pterygo-spinosum will offer no difficulty in this procedure, but an ossified lig. crotaphitico-buccinatorium can make the injection into the foramen ovale impossible.

Perhaps a simpler, less confusing and more appropriate name for the porus crotaphitico-buccinatorius of Hyrtl would be the pterygo-alar foramen (fig. 4) or canal (fig. 3) depending upon the width of the bony bar completing it, since it stretches between the base and lateral surface of the external pterygoid lamina and the under surface of the great wing of the sphenoid bone. This name would distinguish it from the foramen pterygo-spinosum of Civinini. These two foramina, the foramen pterygo-spinosum of Civinini and the porus crotaphitico-buccinatorius of Hyrtl (pterygo-alar foramen) are situated at nearly right angles to each other, the former has a vertical axis and the latter a horizontal axis. Furthermore these are two definite and distinctly separate structures which may both be present in the same individual on the same side (fig. 6).

SUMMARY

The foramen pterygo-spinosum of Civinini may be described briefly as follows: The total ossification of the ligamentum pterygo-spinosum, stretching between the posterior margin of the lateral pterygoid lamina and the angular spine of the sphenoid bone, completes the foramen pterygo-spinosum of Civinini. Its axis is vertical. It lies medial to the foramen ovale. Most often it is larger and more circular in shape than the porus crotaphitico-buccinatorius but it may be divided partially or completely by bony spines or spicules into two or more distinct parts or foramina. The nerve and vessels to the internal pterygoid muscle often pass through it.

The porus crotaphitico-buccinatorius (Hyrtl), preferably called the pterygo-alar foramen, is formed by the ossification of a ligament stretching between the lateral surface and the base of the lateral pterygoid lamina and the under surface of the great wing of the sphenoid bone. Its axis is horizontal. It always lies lateral to the foramen ovale. It is flatly oval in cross section. At least a greater portion of, if not all of the motor part of the (third) mandibular division of the trigeminal nerve passes through it. Some veins of the pterygoid plexus and a few small arteries may also pass through it.

The foramen pterygo-spinosum of Civinini was present 97 times in 1544 skulls studied, or in 6.28% of cases. In 594 Negro male skulls it was found in 3.54% of cases, while in 268 Negro female skulls it was present in only 1.12% of cases. In 576 White male skulls of this collection it was found in 10.76% of cases, and in 106 White female skulls it was present in 10.38% of cases. The percentage in all males was 7.09 and in all females only 3.74.

The pterygo-alar foramen (porus crotaphitico-buccinatorius of Hyrtl) was present 159 times in 1544 skulls of this collection, or in 10.30% of cases. In 594 Negro male skulls it was found in 14.98% of cases, while in 268 Negro female skulls it was present in 8.21% of cases. In 576 White male skulls it was found in 7.47% of cases, and in 106 White female skulls

it was present in only 4.72% of cases. The percentage in all males was 11.28 and in all females 7.22.

The foramen pterygo-spinosum of Civinini and the foramen pterygo-alare (porus crotaphitico-buccinatorius of Hyrtl) were found bilaterally in one skull. Both of them were present on the right side only in 6 skulls, and on the left side only in 10 skulls. In 2 skulls the foramen of Civinini was present on one side and the pterygo-alar foramen (porus crotaphitico-buccinatorius of Hyrtl) on the other side.

The frequency of spines suggesting the beginnings of either the foramen pterygo-spinosum of Civinini or the foramen pterygo-alare (porus crotaphitico-buccinatorius of Hyrtl) was not determined.

The reason for the presence of either of these two anomalies is not apparent. It can only be conjectured that the presence of the pterygo-alar foramen (porus crotaphitico-buccinatorius of Hyrtl) may be atavistic in nature.

Age does not seem to bear any relationship to the frequency of either one of these two anomalies.

The gross examination of the cadaveric material to determine the presence or absence of these anomalies does not appear to be quite as satisfactory as the examination of prepared skeletal material.

The bar of the bone completing the pterygo-alar foramen (porus crotaphitico-buccinatorius of Hyrtl), and not the one completing the pterygo-spinous foramen of Civinini, obstructs the passage of instruments through the foramen ovale in attempts to inject the semilunar ganglion.

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PLATE 1

EXPLANATION OF FIGURES

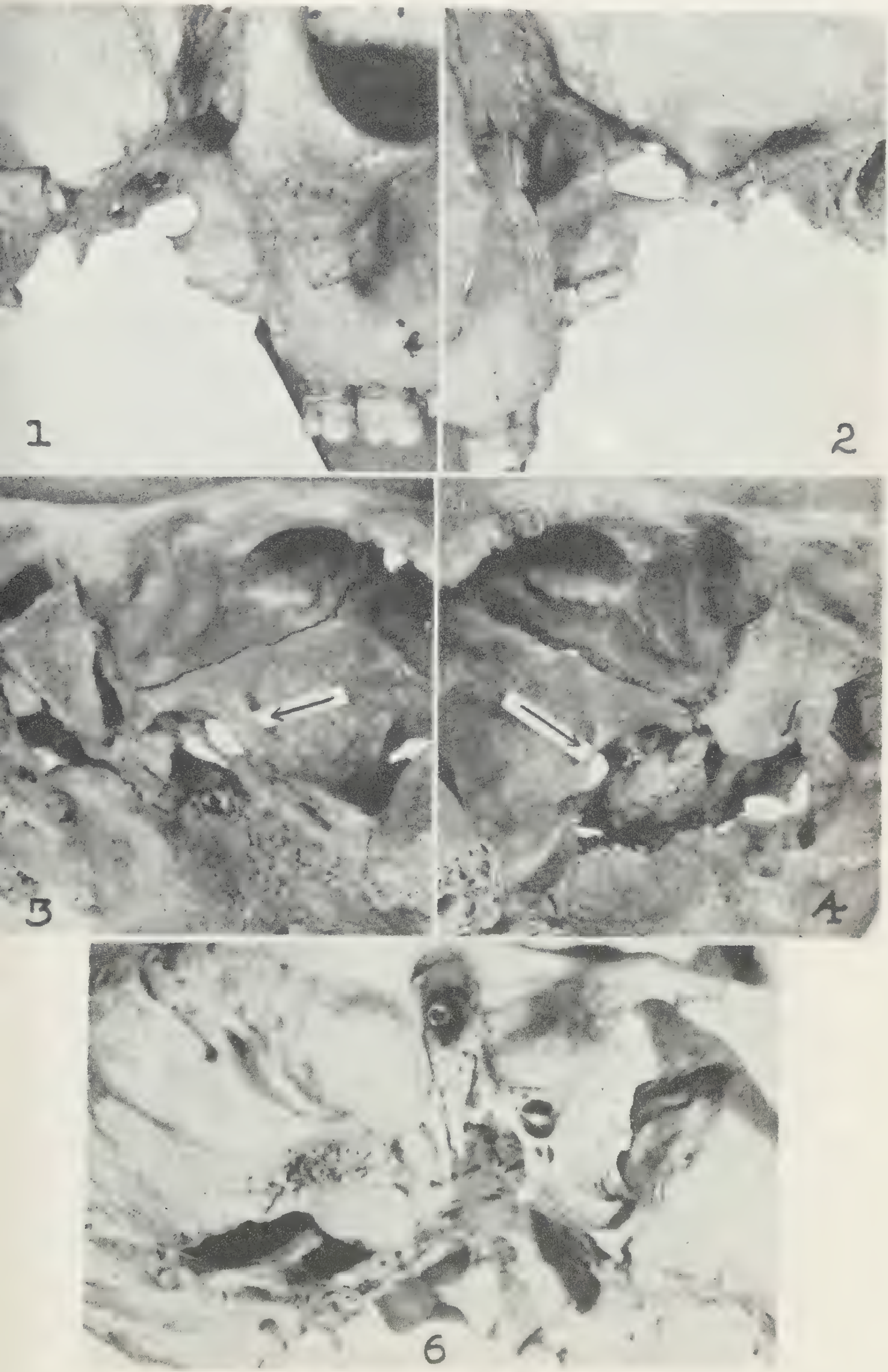
1 The spines of Civinini are seen from the right side. The zygomatic arch has partly been removed. The anterior spine is projecting posteriorly from the lateral pterygoid plate and the posterior spine is protruding forward from the angular spine. They are 4 mm apart.

2 The pterygo-spinous foramen of Civinini is seen from the left side of the same skull as in figure 1. The zygomatic arch has partly been removed. Inside the foramen four more spurious spines are projecting which if elongated and joined will divide the foramen into several parts.

3 The pterygo-alar canal (the porus crotaphitico-buccinatorius of Hyrtl) is seen $1\frac{1}{2}$ mm beyond the tip of the arrow, bridged over by a heavy bar of bone next to which are seen the foramen ovale and the foramen lacerum on the right side. The skull has been tipped over to show all these foramina simultaneously.

4 The pterygo-alar foramen (the porus crotaphitico-buccinatorius of Hyrtl) is seen 2 mm ahead of the arrow, bridged over by a narrow bar of bone next to which is seen the foramen ovale, on the left side of the same skull as seen in figure 3.

6 The foramen pterygo-spinosum of Civinini (divided) and the pterygo-alar foramen (the porus crotaphitico-buccinatorius of Hyrtl) are seen simultaneously on the right side of the skull which is slightly tilted to show both of these anomalies at once. 1084.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Aleš Hrdlička

DISPUTATIO INAUGURALIS,

Quaedam de Hominum Varietatibus, et harum Cauſis, exponens:

QUAM, ANNUENTE SUMMO NUMINE,

Ex Auctoritate Reverendi admodum Viri,

GULIELMI ROBERTSON, S. S. T. P.

Academiae Edinburgenae Praefecti;

NEC NON

Ampliſſimi SENATUS ACADEMICI Conſenſu,

Et Nobiliſſimae FACULTATIS MEDICAE Decreto;

PRO GRADU DOCTORIS,

SUMMISQUE IN MEDICINA HONORIBUS ET PRIVILEGIIS RITE ET LEGITIME CONSEQUENDIS;

ERUDITORUM EXAMINI SUBJICIT

JOANNES HUNTER, SCOTO-BRITANNUS,

Societ. Med. Soc. Hon.

Prid. Id. Junii, hora locoque ſolitis.

———The ſpacious Weſt,
And all the teeming regions of the South,
Hold not a quarry, to the curious flight
Of Knowledge, half ſo tempting or ſo fair
As MAN to MAN. AKENSIDE.

1775.

Part of the title page of a rare item in the Hrdlička Library. The pagination (431–458) indicates that it appeared in volume 3 of Smellie (William). Thesaurus medicus, sive disputationum in academia Edinensi ad rem medicam pertinentinum, a collegio instituto ad hoc usque tempus delectus. 4 v., Edinburgi, C. Elliot et soc., 1778–85. An English translation by Thomas Bendyshe is to be found in "The anthropological treatises of Blumenbach and Hunter," published for the Anthropological Society of London by Longman, Green, Longman, Roberts & Green, 1865. The author of this interesting treatise (d. 1815?) is not to be confused with the celebrated surgeon John Hunter (1728–1793). The chief claim of the former to fame is the fact that his treatise on the varieties of mankind appeared "in the very same year and a month or two before the more famous work of Blumenbach on the same subject." (Bendyshe)

THE VOLUME OF THE SACRAL CANAL[1]

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ONE FIGURE

INTRODUCTION

The introduction of continuous caudal analgesia in obstetrics (Hingson and Edwards, '42) and its increasing use has provoked a thorough investigation of the anatomy of the sacrum, especially in its relation to the level of the termination of the dural sac and to the size of the sacral hiatus (Letterman and Trotter, '44; Trotter and Letterman, '44; Trotter and Lanier, '45). With the work of V. S. Lanier, McKnight and Trotter ('44) to determine the height to which a test dose of a solution would rise when injected into the epidural space, interest was focused on the factors which might influence the level reached by the solution. As shown by them the 30-cm³ initial dose of solution injected through the sacral hiatus into the sacral canal rose to various levels throughout the length of the vertebral column. Therefore, factors which might influence the height of its rise would necessarily be of significance in the management of the administration of the anesthesia. One such factor was suspected to be variation in the volume of the sacral canal. Since no measurements of the volume of the sacral canal have been reported in the literature, the present study was undertaken.

It is the purpose of this paper to report: (1) the variations in volume of the sacral canal; (2) the differences obtaining between the two sexes; and (3) the differences obtaining between the two races, White and Negro.

[1] Aided by a grant from the United States Public Health Service.

MATERIAL AND METHOD

Measurements and observations were made on 400 sacra comprising 100 each of males and females in the two racial groups chosen at random from the Terry Anatomical Collection at Washington University. These are well documented specimens so that the information as to stature of the individual from whom the specimen came was available in most cases. Observations were noted as to the level of the apex and base of the sacral hiatus and to the composition of the sacrum.

The volume of the sacral canal was determined by a modification of Hrdlička's method ('20) for measuring cranial capacity. First, strips of adhesive tape were cut and fastened tightly over the intervertebral foramina; strips were placed over the sacral hiatus in like manner, simulating the ligaments found in the living. A strip was placed transversely across the articular processes of the first sacral vertebra thus building up the posterior wall of the canal to the level of the superior surface of the first vertebra. Next, the canal was filled with shot poured from a glass cylinder, the mouth of which was held at the level of the superior surface of the body of the first sacral vertebra, the sacrum being held in a vertical position. Midway in the filling the sacrum was tipped to either side once; and then as the shot reached the top, the sacrum was tapped smartly five times on each side to settle the shot. The shot was carried to a level with the superior surface of the body of the first vertebra of the sacrum, and leveled off with a straight edge. Then the shot was removed from the sacrum; that adhering to the adhesive was carefully picked off. The shot was then poured through a funnel into a graduate cylinder and the volume read. Figure 1 shows a typical sacrum and a cast of its canal whose volume when measured according to the method just described was 31 cm^3.

After trying various sizes of shot, no. 10 was used for the study because it gave most consistent results on a control series and was convenient to handle. A series of five sacra was used as a control in order to standardize the method at

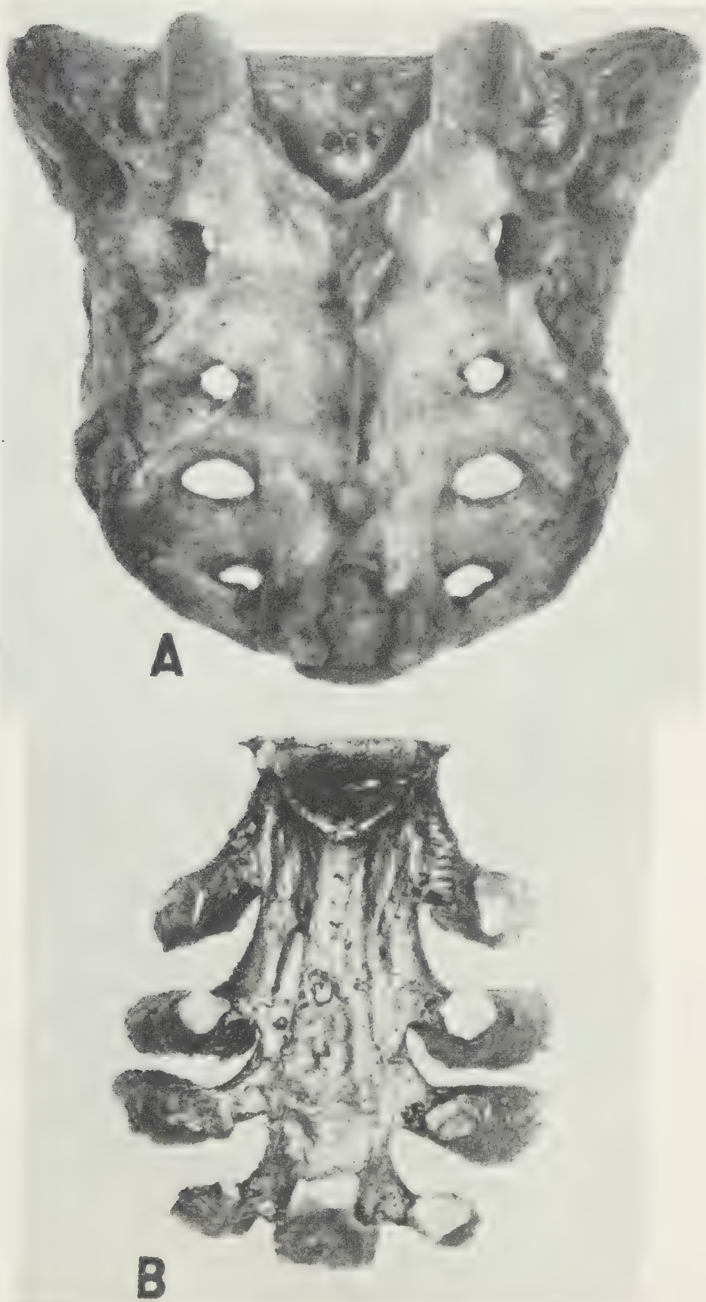

Fig. 1 A. Sacrum of a white male. Dorsal view. B. Dorsal view of lead cast of canal of sacrum shown above.

the start and to check the procedures during the measurements on the large series. It was found that the volume in the cylinder could be read accurately only to the nearest 0.5 cm³. After carrying out several determinations on the control series, volume measurements were found to vary no more than from .5 cm³ to 1.0 cm³, a variation within the limits of estimated error in reading (table 1). From these preliminary findings the method was considered to be sufficiently accurate for a statistical study. Care was exercised throughout the procedure to carry out the steps in the same manner for each of the specimens used.

TABLE 1

Volume measurements (in cm³) on control series.

SPECIMEN NO.	READINGS IN CUBIC CENTIMETERS				
	1st	2nd	3rd	4th	5th
465	29.5	29.0	29.0	28.5	29.0
521	40.5	40.5	41.0	40.5	40.5
915	33.5	33.0	33.5	33.5	33.5
923	28.5	28.5	28.0	28.5	28.0
931	23.0	23.5	23.0	22.5	23.0

TABLE 2

Volume analysis (in cm³) by race and sex.

	NO. OF CASES	RANGE IN VOLUME	MEDIAN	MEAN	PE OF MEAN	σ	SIGNIFICANCE OF DIFFERENCE
White males	100	58.5–23.0	34.0	34.7	± .5	7.75	W♂ vs W♀ = > 99.9
White females	100	56.5–18.5	29.5	30.7	± .5	7.00	W♂ vs N♂ = > 99.5
Negro males	100	55.5–19.0	32.0	32.1	± .4	6.25	N♂ vs N♀ = > 99.9
Negro females	100	65.0–12.0	26.5	28.0	± .6	8.50	W♀ vs N♀ = > 99.4
							N♂ vs W♀ = > 93.0

RESULTS AND DISCUSSION

The volumes were first analyzed for the entire series of 400 and then divided into groups to discover race and sex variations. A study of the figures presented in table 2

indicates that the mean volume of the sacral canal in white males is 4 cm³ greater than that in white females; that almost exactly the same degree of difference (4.1 cm³) also obtains between the Negro males and females. The measured volume is significantly greater in each of the white sexes than in the corresponding sex of the Negro race — approximately 2.5 cm³. However, the sacral canal of the Negro male exceeds that of the white female by a small amount, 1.4 cm³, which is significant to a lesser degree.

Next, each of the four groups was divided according to the composition of the sacrum to see whether or not fusion of the coccyx or of the fifth lumbar vertebra to the sacrum materially affected the volume of the resultant sacral canal.

TABLE 3

Volume analysis (in cm³) by composition of sacrum, race and sex.

	4 SACRAL VERT.		5 SACRAL VERT.		5S + COCCYX WITH BASE ON SACRUM		5S + COCCYX WITH BASE ON COCCYX		5S + 5TH L		5S + 5TH L + COCCYX	
	No.	Mean vol.	No.	Mean vol.	No.	Mean vol.	No.	Mean vol.	No.	Mean vol.	No.	Mean vol.
White males	0	. . .	36	32.3	9	36.6	43	36.1	11	42.5	1	31.5
White females	4	25.6	45	28.4	12	29.0	25	33.0	10	33.2	4	46.9
Negro males	1	23.0	58	31.0	4	31.9	25	32.5	11	40.9	1	37.0
Negro females	1	27.5	57	25.5	6	25.4	17	27.1	17	35.8	2	50.3
Totals	6	25.4	196	29.3	31	30.7	110	32.2	49	38.1	8	41.4

It may be readily observed in table 3 that in those four types of sacra which make up the largest proportion of the cases studied there are some significant differences. When the coccyx is fused and the level of the base of the sacral hiatus lies on the coccyx, the volume averages 2.9 cm³ more than in the 5-vertebrae sacrum, a statistically significant difference. When the coccyx is fused but the base lies on the sacrum, the difference in volume between it and the normal 5-vertebrae sacrum is not significant. When the fifth lumbar vertebra is fused, the mean volume is 8.8 cm³ greater than the

normal sacrum, a fact which one would expect from an empirical examination of the two types of sacra. There are not enough specimens of the 4-vertebrae sacra or sacra in which both fifth lumbar and coccyx are fused to make a statistical analysis; but it appears, as one would predict, that the 4-vertebrae sacrum has a somewhat smaller volume and the 7-vertebrae sacrum a larger volume than the standard 5-vertebrae sacrum. It may be noted, also, that the same variations as to sex and race also obtain when the groups are thus broken up. (The figures for the last type of sacrum are not sufficient to say that the sex and race differences are actually reversed in that sub-group.)

It was thought before the actual measurements were made that the stature of the individual might possibly have some bearing on the volume of the canal; hence stature was recorded in all cases obtainable. Coefficients of correlation between stature and volume were calculated for each of the races and sexes and were as follows: White males, $+ .36 \pm .06$ (98 cases); White females, $+ .10 \pm .07$ (78 cases); Negro males, $+ .23 \pm .06$ (91 cases); Negro females, $+ .28 \pm .06$ (89 cases). One must conclude from these figures that there is no direct correlation between the stature of an individual and the volume of the sacral canal.

SUMMARY

A series of 400 sacra comprising 100 each of males and females in the Negro and White races was measured for the volume of the sacral canal. Observations were also made as to composition of the sacrum, levels of base and apex of the hiatus, and stature of the individual from whom the sacrum came. Results were as follows:

1. Mean volume of the sacral canal in white males is 4.0 cm^3 greater than in white females; the same degree of difference is also present between Negro males and females.

2. The volume is significantly greater in each of the white sexes than in the corresponding Negro sexes — approximately 2.5 cm^3.

3. The sacral canal of the Negro male exceeds that of the white female by 1.4 cm^3, significant to a lesser degree.

4. When the coccyx is fused and the base of the hiatus lies on the coccyx, the mean volume is 2.9 cm^3 more than in the 5-vertebrae sacrum; but when the coccyx is fused and the base of the hiatus lies on the sacrum, there is no significant difference in the two volumes.

5. Fusion of the fifth lumbar vertebra increases the volume considerably — 8.8 cm^3 in the series studied.

6. Correlations between volume of canal and stature of the individual were not significant.

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THE HANDS OF A PITUITARY GIANT.— In 1935 I obtained through the courtesy of Dr. Henry W. Edmonds the hand prints and finger prints of Robert Wadlow, the "Alton giant," who was then 17 years old and 98 inches in height. (The announcement of Wadlow's death, which occurred 5 years later, reported that he had attained a stature of 105.5 inches and a weight of 491 pounds.) This note is to report the results of examination of the ridged skin, with particular reference to the relationship between breadths of epidermal ridges and body size. Studies by the writer and his collaborators (Am. J. Anat., vol. 68, '41; Am. J. Phys. Anthrop., vol. 29, '42; Anat. Rec., vol. 91, '45)

supply standards with which the findings in this case of gigantism may be compared

Hand length, as estimated from the prints, is about 29 cm; in the series of 200 young males furnishing the principal comparative data on ridge breadth mean hand length is 16.9 cm. Doctor Edmonds described the hands as follows: "The skin of the palms is very soft, perhaps more than usually so. The hands are quite supple, and the tapering finger tips are rather flabby, so that the terminal phalanges appear prominent through the surrounding soft tissues." The described character of the palmar skin is reflected in the prints. Major flexion creases are ill defined as a result of the soft, yielding quality of the skin. Fine flexion wrinkles, much more numerous than in a normal hand at this age, appear as a delicate tracery over the entire palm. Impressions of the single ridges are less cleanly defined than is typical, as if they were not firm enough to maintain their elevation under the pressure of the printing operation.

The dermatoglyphics present no configurational aberrancies. The palmar main lines, palmar patterns and patterns of the finger tips are typical.

Breadths of ridges were determined by the method used in previous studies, through counting the number of ridges transecting at right angles to a line of 1 cm. Such counts were used directly for comparative purposes, although the actual average breadth of single ridges may be calculated from them. Counts were made in both hands in the following territories: finger tips, middle phalanges, proximal phalanges, and the five recognized palmar areas. In each of these territories three counts were made; the results are here stated in averages.

Collective regional counts exhibit the same gradients of ridge breadth which have been demonstrated in mass samples of normal subjects. Apical phalanges present the narrowest ridges (count, 17.5), and in order of increasing breadth are the distal palmar territories (12.8), proximal palmar territories (11.9), middle and proximal phalanges (9.5).

The single counts in the Wadlow hands range from 6 to 22 ridges per cm. The counts in the lower range indicate an unprecedented breadth of ridges. When all territories are combined to obtain a mean value the count is 12.5. The mean rises to 15.0 with omission of the extremely coarse-ridged middle and proximal phalanges, necessary because the available normal series does not include them; the corresponding value for the normal group is 20.7. The ratio of these two values is essentially the same as the inverse ratio of height of Wadlow and the average height of normal young men. It is thus apparent that the integumentary ridges are individually enlarged in proportion with body size.— Harold Cummins, Tulane University.

A METHOD FOR ASSESSING THE DEVELOPMENT OF THE HAND SKELETON [1]

NICHOLAS MICHELSON
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In the opinion of many investigators, the consecutive phases of skeletal maturation of the hand, as seen in roentgenograms, constitute very important criteria for the appraisal of the individual's rate of physical development. From the methodological point of view, the assessment of skeletal development is still in an experimental stage and is most difficult for those age groups in which the appearance of an ossification center cannot be used any more as a landmark. Moreover, it seems that after completion of the growth cycle, some young adults still continue to show a slow process of resorption of the developmental ossification markings. This terminal stage of skeletal maturation has not received enough attention.

In 1940 I succeeded in devising a classification for the consecutive ossification of the bones of the hand including the distal ends of the radius and ulna, exclusive, however, of the carpals.

A comparative study of roentgenograms was undertaken. One series was derived from a poor population on whom consecutive pictures were taken, not less frequently than one year apart on the same child. The material was assembled in the Mott Haven Clinic, and covers 4 years of observation. Another series, lacking repeated observations, was obtained from the Hebrew Orphan Asylum. Single pictures were also obtained on a better-to-do class; namely, in the Lincoln and Walden Schools, both of New York City. In view of the

[1] Number 9 of the author's "Studies in physical development."

scarcity of the follow-up material obtained on Negroes, the study had to be confined to Whites.

The findings on the distribution of the type of calcification according to age and the distribution of age according to the type of calcification, as determined for different socio-economic strata, will not be given in this paper. Nor will age equivalents be presented here. The aim of this communication is merely to describe the method of classification which was found to be workable.

My approach corresponds to the one applied by Hellman ('28); namely, a standardization of the degree of progressive maturation of the individual bone. This is in contrast to the method of Todd ('37) whose forty standards characterize the maturation of the entire skeletal composition of the hand. My task was to supplement Hellman's system which distinguishes five phases of maturation, by transitional categories in order to cover in detail the whole range of development of the bones of the hand.

I have formulated criteria for twenty-two consecutive stages, beginning with the pre-epiphysial state, and ending with complete ossification. The method evolved empirically from the following criteria: (1) The presence or absence of an epiphysis; (2) the extent of the gap between diaphysis and epiphysis; (3) the ratio between the width of diaphysis and epiphysis; (4) the appearance of a serrated edge at the base of the diaphysis, a phenomenon which just precedes the next stage when contact between diaphysis and epiphysis follows; (5) the morphological type of the calcification between diaphysis and epiphysis; (6) the ratio between the width of the calcification where it actually contacts the epiphysis, and the width of the epiphysis; (7) the extent of resorption of the calcification between diaphysis and epiphysis; and (8) the extent of resorption of intra-epiphyseal opacities. The last two criteria apply, of course, to the later stages of ossification.

I should like to make it clear that though measurements of the length of the growing bones were utilized in the survey,

the increase in length was considered as a separate entity in order not to confound the increment in the longitudinal dimension with the morphological criteria of maturation. However, in defining the consecutive stages of maturation, I have taken into account the growth factor; and, as already mentioned, I did it by measuring the width of the diaphysis, epiphysis and of the calcification connecting them. The relative width between diaphysis and epiphysis and between the epiphysis and the adjoining mass of ossification, both constitute important indices.

After a scrutiny of roentgenograms showing the right and left hand skeletons of 1200 individuals, I became aware of the co-existence of multiple features in the same age group of the same type of population. Such synchronous polymorphous manifestations must be considered as equivalents for one and the same stage of maturation. In the table of criteria (table 1) I have grouped together the descriptions for the exchangeable forms of calcification and listed them under the standard number to which they belong.

By applying this method to all phalanges and metacarpals, as well as to the radius and ulna, the tempo of development of these bones can be evaluated with equal accuracy. I should like to emphasize that the rate of development of the distal ends of the radius and ulna is slower than that of the phalangeal and metacarpal bones. Moreover, as a rule, the radius and ulna go from stage 15 into stage 16b of my classification; then into stage 19a, and finally, into 20a and 21.

From the morphological point of view, it is important to stress that the following stages are rarely encountered in the radius and ulna: 16a, 17a, 17b, 18a, 18b and 20b.

Under the direction of the late Prof. Franz Boas, Dr. Dusya Trachtenberg made calculations whose purpose was to find out whether the relation between the age groups of the individuals under study and the corresponding stages of development as determined from the roentgenograms of their hands, followed a definite rule. Such a correlation could be determined, since the twenty-two stages of progressive matur-

ation of the bones of the hand appeared to be equidistant. The efficacy of any system of classification of the consecutive maturation of the bones of the hand hinges on the formulation of stages of development which bear the same relationship among themselves as the rungs of a ladder in which the distance from any rung to the next one is equal. The progress of development of a bone may tarry or skip a step.

As far as the carpal bones are concerned, when dealing with consecutive observations, I have recorded the subject's actual age at appearance of the bone on the film; and when dealing with single observations, I have calculated the percentages for the presence and absence of a given carpal bone in a given age group. These statistical approaches supplement each other (Michelson, '45).

At this point I should like to draw attention to a few technical items. To save time and energy, one can investigate the development of only one part of the hand skeleton. For example, one can restrict oneself to a comparative study of the ossification of the middle finger among different socio-economic and racial entities.

To reduce cost, either the right or the left hand can be x-rayed. In a follow-up study, only observations on the same hand are comparable.

Roentgenograms which were not specifically intended for anthropological study, are, as a rule, inaccurate for this type of research. Paper films or photographs of films also must not be used, because they are unreliable as to the density of calcifications, and especially discrete formations. The hand skeleton must appear on the film in natural size, for otherwise measurements have no validity. Measurements on the film should be undertaken by means of a transparent ruler.

In order to obtain proper visualization of the distal end of the radius and ulna while taking the roentgenogram, the subject's forearm should rest on the table and the entire arm be held straight. Unnecessary lifting of the carpus must be avoided. In order to avoid fore-shortening or distortion, the hand must be placed on the film cassette firmly. Children

must not raise or curve any part of the finger. Without such a precaution, the gap existing between epiphysis and diaphysis will either be reproduced as too narrow or will not appear at all on the film, and parts of the diaphysis and epiphysis will overlap.

The elimination of an inconclusive technic in reference to the taking as well as the measuring of the pictures can only be accomplished on the basis of experience. It seems to me that the results are most reliable if one and the same person is charged with the task of taking the pictures and measuring them. At all events, if only one person measures the pictures, there should be a check-up, at the beginning of the work, by a collaborator. The entire material, however, must have the final stamp of but one investigator. This reduces errors due to subjective factors, and enhances a greater uniformity in judgment.

The consecutive stages of development of the hand skeleton are presented in table 1. It appears from this table that my system of classification is a combination of quantitative measurements and qualitative determinations. Undoubtedly, the element of characterization constitutes the weak part of the method, because different investigators may disagree on qualitative concepts such as "medium" or "intense" density of contacting tissues; or a "sharply" and a "less sharply" defined demarcation between diaphysis and epiphysis. However, in applying the criteria to consecutive roentgenograms of growing individuals, errors of judgment can be corrected by the investigator when comparing follow-up films taken on one and the same person during various time periods of the growth cycle. Ideally, from the methodological point of view, a unitary category of criteria, all quantitative in nature, would be most desirable. Unfortunately, morphological processes as revealed on the roentgenograms of the developing hand skeleton, cannot be appraised without eliminating descriptive, qualitative concepts.

It is hoped that by testing these standards formulated for the consecutive stages of osseous maturation of the hand and

TABLE 1

Classification of the consecutive stages of development of the hand skeleton (exclusive of the carpals) [1]

STAGE	CRITERIA OF MATURATION
0	Epiphysis absent.
1	Epiphysis about 1 mm in width. Wide gap between diaphysis and epiphysis.
2	Width of epiphysis less than $\frac{1}{2}$ width of diaphysis. Distinct gap, about 1 mm wide, between diaphysis and epiphysis.
3	Width of epiphysis equals or exceeds $\frac{1}{2}$ width of diaphysis. Gap between diaphysis and epiphysis at least $\frac{1}{2}$ mm wide.
4	Width of epiphysis less than $\frac{3}{4}$ width of diaphysis. Gap between diaphysis and epiphysis nowhere less than $\frac{1}{4}$ mm. Gap may be narrow in its entirety, in the center only or at one side.
5	Width of epiphysis approaches or exceeds $\frac{3}{4}$ width of diaphysis. Gap between diaphysis and epiphysis averages about $\frac{1}{2}$ mm. Gap may be $\frac{1}{4}$ mm in center and wider ($\frac{3}{4}$ mm) bilaterally or at one side only.
6	Border of diaphysis facing epiphysis serrated. Width of epiphysis exceeds $\frac{3}{4}$ width of diaphysis. Epiphysis may be of equal width or in rare instances wider than diaphysis. Gap between diaphysis and epiphysis $\frac{1}{4}$ mm or less.
7	Contact between diaphysis and epiphysis established. Contact may be at one or two points, or by means of thin or fluffy meshes. Width of epiphysis greater than $\frac{3}{4}$ width of diaphysis.
8 (a)	Contact between epiphysis and diaphysis less than $\frac{1}{2}$ width of epiphysis. Contacting tissue not dense. Epiphysis a trifle less wide than diaphysis.
(b)	Fairly dense contact, 2 to $2\frac{1}{2}$ mm wide. Width of epiphysis $\frac{3}{4}$ width of diaphysis, but rarely of equal width.
9 (a)	Contact about $\frac{1}{2}$ width of epiphysis. Contacting tissue not dense. Epiphysis slightly narrower than diaphysis or of about equal width.
(b)	Few contacting meshes. Epiphysis wider than diaphysis.
(c)	Contact of 1 mm, not dense. Epiphysis $\frac{1}{4}$ wider than diaphysis.
10 (a)	Contact by means of dense tissue, 2 to 3 mm in width. Epiphysis wider than diaphysis, or at least of equal width.
(b)	Contact by non-dense tissue, greater than $\frac{1}{2}$ width of epiphysis. Width of epiphysis $\frac{3}{4}$ of width of diaphysis or more.
(c)	Contact by tissue of medium density, up to $\frac{1}{2}$ width of epiphysis. Epiphysis as wide as diaphysis, and rarely wider.
11 (a)	Dense contacting tissue, less than $\frac{1}{2}$ width of epiphysis. Width of epiphysis at least $\frac{3}{4}$ width of diaphysis, and may exceed total width of diaphysis.
(b)	Contacting tissue of medium density, up to $\frac{2}{3}$ width of epiphysis. Epiphysis as wide or wider than diaphysis.

TABLE 1 (Continued)

STAGE	CRITERIA OF MATURATION
12 (a)	Dense contact equal to or greater than ½ width of epiphysis. Width of epiphysis exceeds ¾ width of diaphysis and may exceed total width of diaphysis.
(b)	Contacting tissue of medium to intense density. Often both degrees appear in combination. Contact ½ width of epiphysis or slightly more. Epiphysis wider than diaphysis.
13	Dense contact, ¾ width of epiphysis or more. Often small bilateral gaps. Epiphysis as wide or wider than diaphysis.
14	Full contact between diaphysis and epiphysis. Fusing surfaces show a distinct epiphysial scar. Cases with one small lateral gap may be included in this category.
15	Complete contact between diaphysis and epiphysis. Demarcation between them less sharply defined than in previous stage, and showing confluent sections.
16 (a)	Basal density (density in that region of epiphysis most distant from diaphysis) about 3 mm in height at center.
(b)	Distinct, but partially resorbed demarcation line between diaphysis and epiphysis; ⅛ to ¼ of bone fused without scar tissue at this region. Often a spur on the contralateral side.
17 (a)	Basal density partially honeycombed and 2 mm high. In some cases slants, and may be 3 mm high on one side and 1 mm on the other.
(b)	Homogeneous basal density, between 1 and 2 mm high. (This unresorbed calcification must not be confused with a still narrower basal line which is the effect of superimposed shadows formed by the bone's anterior and posterior margins.)
18 (a)	Entire basal density honeycombed; 1½ to 2 mm high.
(b)	Remnant of homogeneous basal density.
19 (a)	Thin, inconspicuous line, corresponding to the almost completely resorbed demarcation between diaphysis and epiphysis. (Cases with minor interruptions of the line's continuity included.)
(b)	Remnant of basal density, honeycombed, 1 mm high, located at center, side or along entire marginal line.
20 (a)	Line fragmentary or merely suggestive, ranging in length from a few millimeters to ½ width of epiphysis.
(b)	A short horizontal dash near the marginal line at the base of the bone (signifying the final resorption of the intra-epiphysial density).
21	Complete ossification. (The resorption signs having disappeared.)

[1] Exchangeable morphological equivalents for one and the same stage of maturation are listed under (a), (b), and (c).

by heeding the procedural groundwork, more details may evolve, especially as regards the age groups bordering on early adult age and also for adults in whom the final process of ossification in the distal ends of the radius and ulna can continue, although adult stature has already been achieved. Thus I have occasionally seen incomplete resorption of epiphyseal scar tissue even beyond the age of 30 years in apparently normal individuals.

It goes without saying that the description of the method of assessing roentgenograms of the hand as proposed herein, ought to be followed by a presentation of tables showing all the stages of bone maturation. The intention is to publish an atlas in which it is planned to include a comparison between my classificatory formulation and the standards of other investigators. The latter will permit a cross-reference for corresponding stages of bone maturation as advocated by different authors.

SUMMARY

A method is presented for the assessment of twenty-two consecutive stages of skeletal maturation of the hand as seen in roentgenograms. The criteria for the classification are explained in the text.

LITERATURE CITED

Hellman, Milo 1928 Ossification of epiphysial cartilages in the hand. Am. J. Phys. Anthrop., vol. 11, no. 2, pp. 223–244.

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Todd, T. Wingate 1937 Atlas of skeletal maturation. C. V. Mosby, St. Louis.

REVIEW

THE PRINCIPLES OF CLASSIFICATION AND A CLASSIFICATION OF MAMMALS. By GEORGE GAYLORD SIMPSON. Bull. Am. Mus. Nat. Hist., New York, vol. 85, xvi + 350 pp., 1945.

The present monograph is the latest of a long and distinguished series of treatises, beginning with that of Linnaeus (1758), dealing with the classification of the Mammalia. It represents the culmination of nearly 20 years of work and is a detailed extension of an outline published by the author in 1931.

The work is presented in three parts. Of these, part 1 deals with the principles of taxonomy, part 2 with the actual mammalian classification, and part 3 with a discussion of the latter. The essay on principles represents a critical review of the science of taxonomy, both as to its past and present methods and its objectives. This section should be carefully read by all who have to deal with taxonomic problems of any sort. The author points out that, in theory, taxonomy should take cognizance of data from genetics, physiology, embryology, geography, morphology including paleontology, etc., but that by necessity it remains essentially a science of the recognition of morphological differences. The latter, we assume, is an adequate expression of the genetic factor. The framework of classification is a system of categories on a hierarchical scale, as expounded by Linnaeus, derived in actual practice from studying samples of groups or populations. Its purpose is primarily to provide a convenient, practical arrangement of the forms considered and secondarily to demonstrate their affinities. The importance of the variation factor is emphasized by the author, with the pertinent admonition that variation is inherent in any valid classification since classification is concerned not with individuals but with groups. The species is the basic unit of classification in theory and the most nearly definable rank in practice, but unfortunately there is anything but universal agreement as to its definition. Hence for this and other reasons the author regards the genus as the most definite and permanent unit of modern classification and as the basic unit of practical and morphological taxonomy.

Simpson correctly regards the decline of taxonomy as having been brought about by its narrowness of concept. He bases his hopes for its revival on the application of broad biological principles to the field. This is undoubtedly a sound point of view and one that holds out considerable hope for the future of taxonomy provided that such principles are actually applied. But the author himself appears to violate

the principles for which he pleads. It is of course a naturally imposed necessity that in fossil forms only the skeleton (chiefly skull and teeth) can be used, but Simpson has largely disregarded the remainder of the animal when dealing with recent forms. It is not that we lack knowledge on these points, for many excellent studies are available. The magnitude of the author's task may well be the explanation; but the fact remains that the present classification, for all its outstanding merit, still is one based essentially on skull and dentition.

This criticism is particularly applicable to the author's treatment of the Primates, the order which is of especial interest to readers of this journal. Numerous important contributions that deal with skeleton, muscles, viscera and nervous system have not been considered. The disregard of certain notable works on the skeleton is particularly puzzling.

The author's classification of this order, which is novel in certain respects, may be condensed as follows:

Order PRIMATES

Suborder PROSIMII

Infraorder LEMURIFORMES

Superfam. Tupaioidea
- †Fam. Anagalidae
- Fam. Tupaiidae
  - Subfam. Tupaiinae
  - Subfam. Ptilocercinae

Superfam. Lemuroidea
- †Fam. Plesiadapidae
- †Fam. Adapidae
  - †Subfam. Adapinae
  - †Subfam. Notharctinae
- Fam. Lemuridae
  - Subfam. Lemurinae
  - Subfam. Cheirogaleinae
  - †Subfam. Megaladapinae
  - †Subfam. Archaeolemurinae
  - †Subfam. Hadropithecinae
- Fam. Indridae

Superfam. Daubentonioidea
- Fam. Daubentoniidae

Infraorder LORISIFORMES
- Fam. Lorisidae
  - Subfam. Lorisinae
  - Subfam. Galaginae

Infraorder TARSIIFORMES

†Fam. Anaptomorphidae

†Subfam. Paromomyinae
†Subfam. Omomyinae
†Subfam. Anaptomorphinae
†Subfam. Necrolemurinae
†Subfam. Pseudolorisinae

Fam. Tarsiidae

Suborder ANTHROPOIDEA

Superfam. Ceboidea

Fam. Cebidae

Subfam. Aotinae
Subfam. Pithecinae
Subfam. Alouattinae
Subfam. Cebinae
Subfam. Atelinae
Subfam. Callimiconinae

Fam. Callithricidae

Superfam. Cercopithecoidea

Fam. Cercopithecidae

Subfam. Cercopithecinae
Subfam. Colobinae

Superfam. Hominoidea

†Fam. Parapithecidae
Fam. Pongidae

Subfam. Hylobatinae
†Subfam. Dryopithecinae
Subfam. Ponginae
†Subfam. Australopithecinae

Fam. Hominidae

The outstanding feature of this classification is the inclusion of the tree shrews, the Tupaioidea, with the Primates rather than, as traditionally, with the Insectivora. This is not original with the author, however, for such a step was suggested by Carlsson ('22) and seriously proposed by Le Gros Clark ('34); but it represents an innovation in so far as a major taxonomic revision of the Primates is concerned. The taxonomic allocation of the Tupaioidea has vexed zoologists for many years, for there are ample reasons on the one hand for placing them with the insectivores and on the other hand for assigning them to the primates. Indeed, did it not run counter to the current tendency of taxonomists to avoid "splitting" wherever feasible, one might be tempted to regard them as comprising a distinct, separate order of

their own. On the whole, it may be said that existing evidence favors inclusion of the tupaioids with the Primates despite their many definite insectivoran affinities, as has been ably argued by Le Gros Clark. But their allocation by Simpson to the series Lemuriformes — in which he again follows Le Gros Clark — is seriously open to question. Indeed, it even appears doubtful whether one can justify the inclusion of the Tupaioidea within the suborder Prosimii in view of the fundamental differences between the tupaioids and the lemuroids and lorisoids in such characters as placentation, chondrocranium, carpus and tarsus, musculature, etc. At the present moment, the most logical treatment of the tupaioids is to regard them as constituting a primate suborder, the Tupaioidea, that is distinct and separate from the Prosimii and all other suborders. This is not "splitting" in the ordinary sense, as objected to by the author and others, but merely recognition of important basic differences between the tupaioids and other primate forms.

A second and perhaps even more doubtful point involves the author's consignment of the tarsioids to his suborder Prosimii. The older taxonomists regarded Tarsius as simply a peculiar sort of lemur. It was a great step forward when Gadow in 1898 recognized the singular features of the tarsioids and placed them in a separate primate suborder. No doubt their incorporation with the lemuroids and lorisoids appears justifiable from the data which the author has considered; but when parts other than the hard ones — such as placenta, reproductive organs, musculature, rhinarium, tongue, etc. — are taken into account, their distinctness from the lemuroids and lorisoids is striking. The reviewer is definitely of the belief that the author's treatment of the tarsioids is wholly unjustified by existing evidence.

With the removal of the tupaioids and the tarsioids, the suborder Prosimii would embrace only the lemuroids and the lorisoids. The reviewer freely admits his lack of profound paleontological knowledge, but it appears to him that dissolution of Simpson's suborder Prosimii is fully justified by current facts relating to both fossil and extant forms. Such dissolution cannot be termed "splitting" in the usual condemnatory sense. In fact, the Prosimii as constituted in the present monograph might well be regarded as an unwarranted "lumping," whether viewed either horizontally or vertically.

Finally, it should be noted that Simpson rejects the union of man with the anthropoid apes in a single family on the grounds of the former's "mentality" and because "there is not the slightest chance" that such grouping will be accepted by zoologists and teachers. He believes, however, that "on the basis of usual diagnostic characters, such as the teeth, viewed with complete objectivity, this union seems warranted." Notwithstanding, it may be remarked that when other

than the "usual diagnostic characters" are examined, appeal to such obscurities as "mentality" is not needed to justify man's exclusion from the family of the anthropoid apes. Indeed, the essential natural unity of man and the anthropoid apes remains more of an open question than the author apparently realizes. This is not the place to enter upon details. It may be noted, however, that there is a considerable mass of data suggesting that the hominid and the anthropoid lines may have been separate even before the differentiation of the Hylobatinae — an interpretation that is sharply at variance with the more orthodox, academic view that links man closely with the three great apes. Time alone will determine which of these views is the more nearly correct. In the light of this uncertainty, the author's choice of the term "Hominoidea" for a superfamily to include the families †Parapithecidae, Pongidae and Hominidae seems unfortunate.

In evaluating such a huge undertaking as this classification, it is easy to dwell upon its inevitable shortcomings, but that should not blind us to its very fine qualities. When considered in toto, it is a truly outstanding achievement, and rare are the individuals who possess the breadth of knowledge and the capacity for synthesis required to produce a classification of this kind. Doctor Simpson has performed a distinct service to all interested in mammalian biology.

William L. Straus, Jr.,
The Johns Hopkins University.

War and Research.— Our colleagues in the war-torn countries have suffered severe hardships, but in spite of this many of them managed to continue investigations. The paper by R. C. Renes, appearing in this issue, is a case in point. Even the history of the manuscript itself is a story of the vicissitudes of war. Doctor Renes writes that he completed the manuscript while his village (Roosendaal, Netherlands) was being shelled. Three copies were made. One was deposited in a safe, another was placed in a farm-house, and the third was carried on the person of the author. The first two copies were destroyed by shelling and fire. For delivery to the Editor the remaining copy was entrusted to an American soldier who was about to depart for the United States.

Dr. Renes since has written that he is serving in the Army of the Netherlands as a medical officer and is now stationed in Java. He has been collecting prints for analyses of the dermatoglyphics in peoples of Surinam and Java.

Racial Terminology.— Various writers have used the terms Indonesian or proto-Malayan to indicate an early, less Mongoloid people in Malaysia and have indicated the Bontoc and Nabaloi Igorot, and the Ifugao, as examples of such a population. . . . In addition to having longer heads and much greater nasal indices, they are usually of stockier build, have heavier features, are darker in color, and more inclined to wavy hair than the coastal peoples. They are far from uniform and many individuals among them approximate the Malayan. As one goes from the Coastal Ilocano and the pagan Tinguian toward the Igorot the population becomes intermediate so that it is impossible, at any point, to say that the people are "Indonesian" as opposed to Malayan. They evidently are related to the Malayan yet are sufficiently divergent to deserve some sort of special designation. Since they apparently antedate the Malayan in the area, the term "proto-Malayan" seems the most appropriate of any suggested. — Fay-Cooper Cole. The Peoples of Malaysia, D. Van Nostrand Co., N. Y., 1945.

Smallpox and the American Indian.—-Before the end of the sixteenth century the whole Atlantic coast of North America had been explored, as well as the northern shores lying along Hudson Bay. The western seacoast was known through almost its entire length as were the lands around the Gulf of Mexico and the islands within the limits of the east coast of North America. Something of the interior of the continent had been learned, and the great water ways, the Mississippi and St. Lawrence rivers, had been discovered. However, not until the following century does smallpox seem to have occurred in the northern part of the western hemisphere. The records of navigators and explorers make no specific mention of smallpox; they specifically refer to scurvy but otherwise contain only vague references to undefined illnesses. Nor is there any mention of these travellers having seen pock marks on the natives, though some of them speak in detail of the markings and coloring of the skin of the natives. — E. Wagner and Allen E. Stearn. The effect of smallpox on the destiny of the Amerindian. Bruce Humphries, Inc., Boston, 1945.

PROCEEDINGS
OF THE FIFTEENTH ANNUAL MEETING
OF
THE AMERICAN ASSOCIATION OF PHYSICAL ANTHROPOLOGISTS

The fifteenth annual meeting of the American Association of Physical Anthropologists was held on April 2 and 3, 1946, at the Anatomy Department of Western Reserve University, Cleveland, Ohio. President Krogman presided throughout the meeting.

A business session was held in one of the parlors of the Statler Hotel on Tuesday evening. The minutes of the fourteenth meeting, having been printed in the Journal, were not discussed. The Treasurer's report for 1945, as follows, was accepted.

TREASURER'S REPORT

Bank balance, December 31, 1944		$ 597.97
Receipts		
Dues	$706.64	
Interest on savings account	9.77	
Interest on Prudence Bond	7.50	
Disbursement on Prudence Bond	75.00	
Viking Fund Grant	450.00	1,248.91
		$1,846.88
Expenditures		
To Wistar Institute for subscriptions to Am. J. Phys. Anthrop.	$434.00	
To Wistar Institute for reprints of Proceedings of 14th Annual Meeting	17.60	
To Inter-American Soc. Anthrop. and Geogr. for dues	3.00	
To Union Am. Biol. Socs. for dues	15.00	
Guests at dinner, 14th meeting	5.00	
Stationery, stamps	18.00	
Printing, typing, mimeographing	19.00	
Secretarial expenses (1946)	25.00	$ 536.60
Bank balance, December 31, 1945		$1,310.28

Endowment Fund

Prudence Bond, approximate value	$ 200.00
U. S. Savings Bonds, maturity value	3,000.00
	$3,200.00

Respectfully submitted,
S. L. Washburn,
Treasurer

Audited and approved:
Carleton S. Coon
Gerhardt von Bonin

Dr. Cobb, reporting for the Nominating Committee (W. M. Cobb, W. W. Greulich, M. Trotter), offered the following nominations:

For Vice-President	Morris Steggerda
For Executive Committee	T. D. McCown
For Associate Editor	W. W. Howells

All were unanimously elected.

The following were elected to membership in the Association:

C. R. Carpenter
H. J. Coolidge
G. C. Davis
Lee R. Dice
J. Franklin Ewing
Arthur Freedman
Donald J. Gray
Arden King
Richard B. Magee
John Manter
William Lessa
Philip Levine
Ruth Smith Lloyd
Nicholas Michelson
Valgene M. Milstead
Samuel Rabkin
J. R. Salzmann
Herluf H. Strandskov
Fernand Van de Ginste
Alexander S. Wiener

Dr. Weidenreich reported on the work of the Committee on International Cooperation in Anthropology and was elected to represent the Association on this Committee for another year.

The Secretary announced that The Viking Fund, Inc., had granted the Association $450 to aid publication in physical anthropology.

The Secretary also announced that The Viking Fund, Inc., had granted $4,000 to aid in establishing a special summer session for physical anthropologists at Columbia University. This sum has been augmented by $1,500 from the latter University. At Dr. Washburn's suggestion the Association voted

$100 to aid the summer session in the publication of a yearbook devoted to physical anthropology.

The Association also voted $50 to continue publication of Dr. Krogman's PA News Letter. Dr. Greulich moved that the Association thank Dr. Krogman for the excellent job he had done on the News Letter. The motion was passed unanimously.

The Editor, in his report, reviewed the contents of the Journal during the past year, and pointed out that the manuscripts on hand would completely fill the June and September numbers. Furthermore he described a new project for filling the blank spaces in the Journal and made an appeal for critical reviews.

The committee to consider the "Proposal for an organization of professional anthropologists" (H. L. Shapiro, T. D. McCown, W. M. Krogman and T. D. Stewart, chairman) reported as follows:

The Proposal leading to the appointment of this committee last October was widely distributed and besides was summarized in the December number of the Journal, so it is assumed that the Association is familiar with its contents. The reaction of anthropologists in general to this Proposal was along two lines: (a) a minority gave outright approval, but (b) the majority, although approving the aims behind the movement, felt that a new organization was unnecessary and that the professional aims mentioned in the Proposal could be achieved through reorganization of the American Anthropological Association. Accordingly, at the Christmas meetings of the AAA held in Philadelphia a "Committee of nine" representing all branches of anthropology was appointed to consider the matter. Apparently this action has the approval of the group sponsoring the original proposal.

In view of these events, your committee feels that no action is required now on the original Proposal. It is the opinion of your committee, however, that any movement designed to protect professional interests is progressive and should receive full consideration. Your committee recommends, therefore, that the Association remain receptive to further proposals along this line.

The Resolutions Committee (J. L. Angel, M. S. Goldstein and H. V. Meredith) introduced the following resolution:

"That we, the members of the American Association of Physical Anthropologists extend our warm and considered thanks to Dr. Normand L. Hoerr, our host, at Western Reserve University, and to Raymond S. Baby, the local committee in charge of arrangements, for our entertainment, intellectual and otherwise."

This resolution was unanimously adopted and the meeting adjourned.

On Wednesday evening, following the last scientific session, the annual dinner was held in the Lattice Room of the Statler Hotel. Following the dinner Dr. Hooton gave an amusing and informative talk on the "Reminiscences of an ageing anthropologist" in which he told of his early contacts with Keith, Hrdlička, Davenport and Terry.

The program of the scientific sessions follows.

1. *Some factors in the mechanism of sex-determination.* R. E. G. Armattoe and Elsa M. McMillan, Lomeshie Research Centre for Anthropology and Human Biology, Londonderry, Northern Ireland. (Read by title.)

It is a common observation that more boys are born in war time. Savorgnan et aliqui (1921) concluded that periodic absence of husbands rather than privation favours the birth of males. From statistical studies (to be presented fully elsewhere) we postulate anxiety states, stress and poverty as important causal male factors in the incidence of high sex-ratio at birth and also of the high selective sex mortality of males at all stages except at the ages of 15 and 45 when pubertal and menopausal complications intervene.

It would seem that economic success militates against biological survival. It is, however, permissible to suggest that deficiency of fats and proteins and excess of carbohydrates in male digametic species favour the appearance of males though they predispose its members to a strong, prenatal, sexually selective mortality because they favour the exhibition of sex-linked recessive factors.

2. *Hair structure related to hair form.* Stanley M. Garn, Harvard University.

In human hair there is a striking correlation between uniformities in structure and the observable hair form. Longitudinal variations include (a) bulbosities, (b) constrictions, and (c) twists. Some body hair and all pubic hair show these variations. The head hair, when its form is non-linear, shows reduction in cross-section thickness and axial torsion accompanying each arc of curvature.

The polarizing microscope supplementing other techniques suggest that these variations in thickness are not accompanied by changes in the chemical composition of the hair but simply represent an increase or decrease in cell productivity during the growth period. The ultimate control factor apparently goes through periodic fluctuations and the form of each hair presents a graphical record of these fluctuations; the growth of the hair provides the x or time axis, and the wave form records motions in the y and z axes.

Specific inheritance of the variations, as well as information on the molecular structure and fibrillar arrangement, is now being sought.

3. *Aurignacian man in Syria.* J. Franklin Ewing, S. J., Boston, Mass.

Two Aurignacian skeletons were discovered in 1938 in a rock shelter at Ksâr 'Akil, about 11 kilometers from Beirût, Republic of the Lebanon, by the Rev.

Joseph G. Doherty, S.J. and the Rev. J. Franklin Ewing, S.J. They belong to the base of the Aurignacian. A well-cemented layer above the skeletons is at present tentatively correlated with LGl_2 (Würm II).

Due to various vicissitudes, these skeletons — the first of their age to be unearthed in Syria — have not yet been extricated from the brecciated matrix. From what has been observed of them, however, the following tentative remarks may be made. The individuals, both young persons about 8 years old, were deliberately buried under a pile of boulders; the skeletons should be reasonably complete.

The more observable skull is characterized by a brain case thoroughly modern in capacity and muscular markings, though somewhat thick-walled and flattened basi-occipitally. The face is robust. The teeth are fairly macrodontic and high-cusped, although modern in pattern. The chin region is straight, with no appreciable mental prominence.

It is hoped that the study of these skeletons will advance the knowledge of Near Eastern Paleolithic Man so strikingly initiated by the excavations at Mount Carmel.

4. Transplantation of developing teeth. Harry H. Shapiro, Dept. of Anatomy, College of Physicians and Surgeons, Columbia University.

The first phase of an experiment dealing with the transplantation of developing teeth is reported for two reasons: (1) to show that such teeth, transplanted from the jaw of one animal into the jaw of another, are capable of differentiating and persisting; and (2) to suggest that such an experimental method may be used to test theories of correlations between developing teeth, and facial and cranial bones. That the validity of anthropological speculation should be confirmed by means of the experimental method would seem to constitute an obvious approach toward the gathering of substantiating evidence; Washburn and Detwiler presented such a view as recently as 1943. Changes in conformation of bones of the face and cranium, resulting from early removal of developing teeth in the pig, cat and rodent were reported by Baker in 1941. The transplantation experiments, as shown in a roentgenologic study made on the cat, in which the transplanted tooth buds were permitted to grow to maturity, offer a synthetic experimental approach to a further knowledge of correlations between teeth, jaws and facial bones.

5. Torus palatinus. Gabriel W. Lasker, Bronxville, New York.

Torus palatinus, a bony downgrowth along the midline of the hard palate, has been studied in 280 Chinese, in over 300 white Americans, in twelve pairs of like-sexed twins and on other material. Torus palatinus occurs more frequently in American-born Chinese than in immigrant Chinese brought up in China. This suggests some etiologically important environmental factor. However, torus palatinus is ordinarily concordant in identical twins and shows a tendency to run in families. The hereditary factor is therefore probably also very important. The presence of torus palatinus is correlated with torus mandibularis and with maxillary and mandibular alveolar hyperostoses, but not appreciably with a wide variety of other dental traits. Tori occur much more frequently in females than in males, especially the more prominent types. This might be explained if one of the important causative factors is inherited as a sex-linked Mendelian dominant. The unequal sex ratio should prove helpful in determining the sex of skulls.

The very complexity of the causative factors affecting this trait coupled with the ready accessibility to examination in living subjects make a study of torus palatinus a promising point of departure for investigation into the principles of human bone growth.

6. Growth of Mexican infants born in the United States and Mexico. Marcus S. Goldstein, U. S. Public Health Service, Bethesda, Md.

Data are presented on body weight of two groups of infants of Mexican mestizo descent, one group born in the U. S., the other born in Mexico. At birth the U. S.-born infants weighed (means): 42 males, 3379 gm; 51 females, 3261 gm. These weights are 256 and 281 gm more than the Mexican-born infants of corresponding sex. These differences are statistically significant. No statistically significant differences occurred between the two groups after birth until the eighth month in the males, eleventh month in the females, when the U. S.-born infants again were heavier.

The greater weight in late infancy of the U. S.-born infants is considered the result of relatively better nutritional status and health conditions. Likewise the greater body weight at birth of the U. S.-born infants is probably due to generally better circumstances and perhaps more widespread prenatal care (ca. 30%) among the mothers of the U. S. group.

Body weight of the U. S.-born infants of Mexican descent compared favorably, between birth and 12 months, with weight of Baltimore "white" infants of a similar economic level.

7. The representation of brain fissures on the endocranial casts of anthropoids and man. C. J. Connolly, The Catholic University of America.

The degree in which the fissuration of the brain is reproduced on endocranial casts is of considerable interest but there is no general agreement on the matter and doubt has been expressed regarding the interpretation of the impressions on those of fossil man. In the anthropoids, different results have been obtained in tests made by different investigators. In the case of man, it is known that fissural impressions are frequently present on the lower parts of the endocranial casts, but they are sometimes said to be neither so distinct nor so generally distributed on the vault in recent man as in fossil man. The problem seemed worthy of further investigation and a series of endocranial casts of anthropoids and man were made in the U. S. National Museum and compared with the corresponding brains where available.

The anthropoid endocranial casts examined consisted of 10 orangs, 2 gorillas and 4 chimpanzees. Among these the best fissural impressions were seen in a young adult chimpanzee with vault and base sutures closed. Here the impressions are present over the greater part of the entire surface and the lunate is represented on both sides.

Among twelve endocranial casts of man representing different ages the maximum degree of fissural representation was found in three adolescents — White, Negro and Indian. In older specimens the fissures may be well defined on the lower parts such as the inferior frontal region, but in specimens of the old, these may

be wanting and the entire endocast quite smooth. Hence age or condition of the sutures plays a role here as in anthropoids.

In both anthropoids and man fusion of fissural furrows often takes place; the location of a fissure on the brain may have an expansion on the endocast, rather than a depression; a furrow along the trace of the lambdoid suture may simulate a lunate sulcus not actually present on the brain or if present, placed more posteriorly; and in the endocast of man the anterior Sylvian branches enclosing the frontal operculum are, as a rule, not represented, and never completely.

But the fissures are sometimes well reproduced on the endocasts, and in human adolescents the fissural representation may at least equal that present on the endocranial casts of fossil man.

8. The amputation prosthesis: a new field for dynamical physical anthropology. T. D. McCown, University of California.

The research here reported represents a project now under way in the College of Engineering of the University of California. The program is being carried out under the auspices and through the support of the Committee on Prosthetic Devices of the National Research Council. Director of the work is Professor Howard D. Eberhart, of the Division of Civil Engineering, and associated with him is Professor A. S. Levens of the Division of Mechanical Engineering, Dr. Verne T. Inman, Clinical Instructor in Orthopedic Surgery, Dr. John B. deC. M. Saunders, Professor of Anatomy, both the latter from the University of California Medical School, myself and several others.

Initially the investigation was planned to study the mechanics of the motion of the leg. This phase of the project is analyzing and measuring the range of motion of the lower limb, especially the motion taking place at the hip and knee joints. Particular attention is focused on the rotation of the several parts, both absolutely and relatively. Electromyographic studies of phasic action of the leg muscles are a correlative investigation.

The anthropometric survey was set up with the view of assembling information which might be used to establish three-dimensional standards for artificial arms or legs, and their component parts. The data from 3300 subjects thus far measured will be used to establish models and also to determine a scheme whereby the individual subject may be related to the standard series.

The locomotion phase of the overall program has been modified to include dynamical studies of the external reactions on the foot using a force plate. Design and structural analysis and accelerated testing of prostheses form additional parts of the program.

All parts of the investigation are based upon the assumption that a thorough understanding of the normal individual in terms of mechanical and dynamical analysis will provide the most effective solution to the problem of altered dynamics and mechanics with which the amputee must cope.

9. The grid technique of evaluating growth and development in infants and children. Norman C. Wetzel, Cleveland, Ohio.

Evaluating the quality of human growth is an essential step in appraising the physical condition of infants and children. Whatever descriptive purpose the

usual indices, age-averages, etc. have served in anthropological studies, they have not provided informative criteria for evaluating the growth of individual subjects in pediatric work, and more particularly, for identifying examples of growth failure under conditions of mass survey or health supervision.

To this end, the grid technique, as originally described for use among school children, and as now extended to infants, has been designed to extract from routine data on height and weight explicit information on two fundamental questions: (1) the direction, and (2) the speed, of physical development. Closely linked with (1) is the constancy or ''preservation'' of physique in healthy subjects, except during pre-school life when slenderization normally takes place; hence, the importance of detecting physique changes at times when physique should remain invariant despite continuing increase of size.

A ''channel system'' determines whether a subject is conforming to the tolerance limits of variation due to chance or exceeds these as a result of systematic and directly assignable cause. Similar limits are supplied for assessing speed of development. Body size, measured in ''levels of development'' is directly associated with body surface, body volume, vital capacity and caloric energy requirements. Pitfalls arising from the fallacies inherent in traditional methods, especially from failure to distinguish ''static'' from ''moving'' components of growth are avoided, and replaced by a scheme which enables each child in fact to become ''his own standard of comparison.''

10. Permanent mounts of gross anatomical sections in ethyl methacrylate. David L. Bassett, Department of Anatomy, Stanford University School of Medicine. (Introduced by W. W. Greulich.)

Unstained thick sections of a human hand which have been dehydrated in dioxan and cleared in xylol are embedded in blocks of ethyl methacrylate (Plexiglas). Detailed three-dimensional relationships are visualized by transmitted light and the sections are suitable for study at high magnifications with the binocular dissecting microscope. These preparations are permanent and practically indestructible.

11. A dental and facial study of triplets. Arthur B. Lewis. The Samuel S. Fels Research Institute, Yellow Springs, Ohio.

Dental casts and lateral head roentgenograms form the basis of the report. The subjects are two sets of male triplets, one 17 years of age, and the other 5. Data consists of measurements of tooth size, width and length of dental arches, and measurements of various angles of the face as obtained from the head plate.

12. Differential tissue growth and sexual maturity. Earle L. Reynolds, The Samuel S. Fels Research Institute, Yellow Springs, Ohio.

This is a report on a study of the relationship between sexual maturity and differential growth patterns of fat, muscle and bone. Fifty children of each sex, from the Fels Research Institute, provide the longitudinal measurements, physical examinations, x-rays and photographs on which the study is based.

The relationship of onset of puberty to the growth patterns for each of these three tissue components is examined, and the individual nature of each pattern is illustrated. Differential tissue patterns for early and late maturing children are compared. Both group tendencies and individual cases are shown.

13. Constitutional obesity. J. L. Angel, K. Paschkis, R. A. Matthews, R. Schopbach and P. C. Swenson. Jefferson Medical College.

After correction of measurements by 10–14% as suggested by x-ray studies, forty-five obese white females studied at Jefferson Hospital's Curtis Clinic diverge from Bayer and Gray's healthy working women toward Draper's gall-bladder group. The sample, averaging 40 years old, is significantly short and small-boned, with deep, long trunk; short span; small hands; short, wide and low (collapsed) feet; short head; wide, low, and broad-jowled face; rather infantile blobby nose; and greenish mixed irides. Excess variability occurs only in measurements directly affected by fat. The sample is not heterogeneous and is limited to mainly endomorphic physiques occupying less than 10% of the normal somatotype range, showing apparent infantile and andric trends, with lipophilic dysplasias and Alpinoid or ''infantilized Upper Paleolithic'' racial type concentration. Parents are called ''average'' in build by only one quarter of the patients. Uncorrected basal metabolic rate is $+.3$.

Ancestors came dominantly from Italy, Ireland, and Germany, though 90% of the sample are native born. Many are unhappy, unintellectual, married, ''minority group'' members with average of only 2 children but over four brothers and sisters. Almost half admit they were fat before 20. Socio-psychiatric histories suggest difficult childhood environment with parental rejection and suppressed but increased need for affection unsatisfied by marriage (excess children or infidelity or other sexual dissatisfaction), with stress on infantile and visceral constitutional tendencies and overeating as an escape mechanism.

Poor posture with hypertrophic arthritis, dyspnea, dizziness, cardiovascular-renal or gall-bladder or other disorders, and psychological depression follow established obesity.

14. Anthropometric instruments. Morris Steggerda, Kennedy School of Missions, Hartford, Conn.

Since standard anthropometric instruments are difficult to obtain and their price prohibitive to most individual scientists, it seems expedient to investigate whether such instruments can be made locally and at less cost.

The Swan Tool and Machine Company of Hartford, Connecticut, under the author's direction, designed and made a jointed metal rod which, when pieced together and fitted onto the top of a sturdy mahogany box, rises to a height of 7 feet. A Lufkin steel tape with metric gradations is attached at the upper end of the rod. The tape can be pulled down and fastened to the lower end of the rod at the level of the top of the box. This box serves also as a platform upon which the subject can stand.

This tool company also made a sliding caliper and a spreading caliper, designed after those of Martin, but of a less expensive metal. The 7 feet of tubing, the

tape and calipers were made to fit inside the box which is designed also as a carrying case for these tools and blanks, pencils and other anthropometric supplies. All this is to sell for a sum not to exceed $50.00

A tool maker in New York City, under the direction of one of the author's students, Mr. George Dunger, has made a model of the standard anthropometer, using a small metric tape which is inlaid into a groove on the rod. This tape serves as a substitute for hand engraved millimeter markings of the Martin anthropometer. The first model serves only as a demonstration and as a basis for discussion, for it is now being re-modeled so that the upper end also can be used as a caliper. It is hoped that this anthropometer will be as serviceable as the standard instrument, and produced singly at a cost of approximately $50.00. The need of producing good, inexpensive, instruments is apparent to the author who teaches anthropology annually to a large and interested class of missionary students.

This paper is merely a progress report. It is hoped that before long a detailed description of these instruments can be published.

15. Anthropometric instruments. Charles E. Snow, University of Kentucky.

A wooden anthropometer set offers a quick and economical solution to the current instrument situation. Possibly the meter sticks can be plastic-impregnated as a means of preventing warpage under warm-humid conditions. The present instrument can be made for about $20.

A new sliding caliper with coordinate attachment, of larger size than the Martin type, affords measurements of elevation at any point of given diameter. Yet the attachment occupies only a space of 5 mm on the calibrated beam of the instrument.

A new craniophore with direct attachment of an accurate goniometer makes possible dependable measurements of various angles, particularly of the facial skeleton.

These instruments were made by the skilled instrument maker, Mr. Karl A. Schneider of the Department of Physics, University of Kentucky, under the direction of Professor William S. Webb, Head of the Departments of Physics and Anthropology, and the author. The craniophore was originally designed by Dr. Marshall T. Newman while at the Peabody Museum, Harvard University. Many modifications were made by Mr. Schneider and the author.

It is hoped that the design of these instruments may appeal directly and be of service to others; or better, that they may contribute suggestively toward continued improvements.

16. The question of classification of the American Indian. Georg K. Neumann, Indiana University.

From a taxonomic point of view it is not possible to set up an American Indian subspecies separate from an Asiatic one, as there is not a single morphological attribute that would separate all American Indians from all of the yellow-brown Asiatics. The varieties of America therefore have to be considered as equal in rank with the varieties of Asiatic Mongoloids as part of a single subspecies — asiaticus.

According to present data most New World forms fit into a classification consisting of twelve varieties, although it would be erroneous to force all types into

a preconceived system. From distributional and archaeological evidence we may conclude that the sequence of entry into the Western Hemisphere was (1) Fuegid, (2) Lagid, (3) Margid, (4) Centralid, (5) Sylvid, (6) Pacifid, and (7) Eskimid. The Centralids later gave rise to the Isthmids, Andids, and Brazilids; and the Prairids and Pampids developed as secondary races from mixtures.

None of these taxonomic units represents a new grouping; each has been recognized as an entity for a long time. Therefore the proposed classification differs from others only in that the limits of the varieties have been changed with the placing of greater emphasis on the time element, and the suggestion of an hybrid origin for the Prairids and Pampids. Various degrees of differentiation, two kinds of primitiveness, as well as two types of specialization have to be taken into account to interpret the racial history of the American Indian so that it agrees with known archaeological evidence.

17. *The problem of defining physical ethnic traits in the individual.* E. S. C. Handy, Oakton, Virginia. (Read by title.)

The problem is to define traits peculiar to the major ethnic strains that enter into the composite Old American Whites in the Middle Atlantic states, whose forbears are known to have come from parts of the British Isles and Europe where ethnic types in the population have been relatively stable in recent centuries and hence are subject to definition in terms of racial characters, following Coon's classification and description of Europoids. The region of observation limits the range of types because the strains studied are derived almost entirely from settlers who came from southern England and Wales, North Ireland and Scotland, from Huguenot France and the Protestant Rhineland. For the sake of simplification also, the morphology of head and face are here considered, excluding for the time being the trunk and limbs.

18. *Re-examination of the human skull found by Gidley and Loomis in association with a Pleistocene fauna at Melbourne, Florida.* T. D. Stewart, U. S. National Museum.

The Melbourne skull was reconstructed by Hrdlička in 1937, 12 years after its discovery by Gidley and Loomis. The result was exhibited at the eighth annual meeting of this Association held in Cambridge. According to the abstract (no. 20) in the Proceedings, Hrdlička stated that "the reconstruction shows the usual type of Indian crania from mounds of the general region [of Florida]."

Because the fragments were applied to a ball of modeling clay for support, it was impossible to evaluate the accuracy of their union. Accordingly, a new reconstruction has been made that depends for its shape on tight joints between the fragments. Where the first reconstruction is ultrabrachycranic, the second is dolichocranic. In this respect it is like the Vero skull found earlier under similar circumstances. Such extreme long heads are very uncommon among Florida mound crania and conform with the present concept of the earliest type in America.

It is concluded that there is no morphological basis for denying this specimen the Pleistocene or perhaps early post Pleistocene age indicated by faunal associations.

It is felt that Hrdlička's reconstruction was not purposely intended to be misleading. He fully believed that America was not peopled until recent times. Probably through his fixation upon this belief he became convinced that his reconstruction was essentially correct.

19. *Anthropology of the Arab Bedouin.* William M. Shanklin, American University, Beirût, Syria.

In their observable features the Syrian Bedouin (Rwala, Akeydat and Maualy) are very similar to one another and to the Transjordan Bedouin (Howeitat and Beni Sakhr). The skin color is usually medium or light brown, and the hair brown or black. The eyes are most frequently dark brown with variations such as light brown, gray brown and blue brown. The head hair is wavy or straight and of medium quantity but the facial hair is relatively sparse. The nose is usually high and straight.

The measurements and indices show that the Howeitat, Beni Sakhr and Rwala are very similar. All three groups have very low statures (mean 163 cm) and are small featured. In sharp contrast the neighboring Akeydat and Maualy are tall (mean 169 cm) and large. A statistical comparison indicates that these tall tribesmen are similar in size to some of the tribes in the Rif.

The writer suggests that there are two varieties of the Mediterranean race living in the Transjordan and Syrian deserts. The small variety, represented by the Howeitat, Beni Sakhr and Rwala, perhaps belong to the Mediterranean race proper described by Coon, 1939. The large variety, represented by the Akeydat and Maualy may belong to the Atlanto-Mediterranean race which includes most of the present day peoples of northwest Africa.

20. *Size, special form and pattern of the human brain in the light of evolution.* Franz Weidenreich, American Museum of Natural History.

The gradual increase of the encephalon, particularly that of the hemispheres, is a phenomenon characteristic of all mammals. The lobes participate in it almost equally. The enlargement ceases in later phases and finally stops, while the brain undergoes a bending of its whole body along a transverse axis which crosses the infundibulum. This bend lifts the vertex and pushes the occiput downward, closely corresponding with a protrusion of the skull base into the cranial cavity (saddle angle), the vertex of which is represented by the dorsum sellae. This protrusion conforms to a fuller adaptation to the erect position of man.

As long as the growth rate of the brain remains higher than that of the body, the brain determines the form of the braincase. From the moment when the body rate prevails, the braincase models the brain. This is proved by comparative studies of vertebrates whose skulls and brains are adapted to those special body structures which deviated from the original quadrupedal pattern.

Under normal conditions, neither the size of the brain nor its special form nor the character of its surface pattern allows any conclusions to be drawn with reference to mental ability or particular psychic faculties, regardless of phylogenetic phases, individuals or racial groups. The brain offers no more clues with regard to type or specific character of any specimen than do the skeletal parts of the body.

21. Observations on the skeleton of the gorilla. John Eric Hill, American Museum of Natural History, New York.

To illustrate the gorilla skeleton as a whole, it was found necessary to articulate one. Brenda Putnam, sculptor, first made a scale model based on photographs, notably of Bamboo (Philadelphia Zoological Society) and studies of living juveniles in Central Park Zoo, New York. Correlations were also made with a partly dissected individual.

The lumbar spinal curve, while less than that of man, is developed in the gorilla. The legs are not extended under the body when bearing the maximum weight but are flexed, although in the first phase of the stride the lower leg can be extended almost in line with the thigh. The weight comes down on the outer side of the foot and the great toe is then adducted, but toward the takeoff the weight shifts to the medial side and the great toe is abducted and carries a large share. The semi-upright posture can be maintained only by great muscular effort; the body is not in vertical balance.

The gorilla has a foot primarily adapted for grasping rather than for weight-bearing. The fore limb is relatively massive in relation to the hind limb. The thumb, in spite of its ''degenerate'' appearance, can be used in fine manipulations.

22. Notes on the upper extremity of the gorilla. Emanuel B. Kaplan, Department of Anatomy, Columbia University.

In the morphological study of man, the systematic observations of variation of structure are of importance. A mere enumerative record is of no significance. When grouped together and compared with the anatomical architecture of the great apes, these variations obtain great practical meaning for the anthropologist and the surgeon.

Dissections carried out on the upper extremities of a young female gorilla showed an arrangement of the brachial plexus which in man is found as a rare variation and which could explain certain pathologic phenomena.

The grouping of muscles of the pectoral region of the gorilla threw additional light on the significance of an infrequent human structure known as Langer's muscle of the axilla, and on its relation to the pectoralis abdominis and panniculus carnosus.

The course of the ulnar nerve and the motor branch of the radial nerve of the forearm in the gorilla indicated possible variations in man which can be responsible for complicated dissociation paralyses of muscles of the hand and forearm in cases of injury to these nerves.

In the specimens dissected there was a complete absence of the m. flexor pollicis longus. An extended insertion of the abductor brevis into the base of the distal phalanx was also noticed. The insertion of the extensor communis digitorum followed exactly the human pattern.

23. Remarks on the brain of the gorilla. Gerhardt von Bonin, Department of Anatomy, University of Illinois.

The brain weight of the gorilla can only be estimated from data on cranial capacities since direct determinations have not yet been made. Cranial capacities

have been measured by several observers; the series agree with each other within the errors of sampling excepting Bolk's data. When these are excluded, the mean cranial capacities for the gorilla are: for 100 males: 506 ± 5.2 and for 70 females: 438 ± 4.7. The sex ratio ($1.16 \pm .02$) differs significantly from both man ($1.12 \pm .007$) and the chimpanzee ($1.09 \pm .026$).

Campbell's study of the cortical architecture is insufficient by present standards and should be improved upon. It is unlikely, however, that even a revised brain map will enable us to understand better the differences between man and the other primates. These may have to be sought in the finer details of cortical organization. It appears that the cell/gray coefficient and the relative size of the Betz cells in the motor area show evolutionary trends. These could be checked in the gorilla brain, and the search for such characters should be continued.

24. *Thoracic viscera of the gorilla.* S. L. Washburn, Department of Anatomy, Columbia University.

Slides show the thoracic viscera of a sub-adult, female gorilla. The general topography of the viscera is determined by the shape of the thorax, and, therefore, provides no more clues to relationship than does thoracic shape. An azygos lobe was present on the right. This lobe is usually present in the gorilla, contrary to the statements usually seen in the literature. There is nothing about the thoracic viscera of the gorilla which indicates any particularly close relationship to man.

25. *Abdominal viscera of the gorilla.* Herbert Elftman and Wm. B. Atkinson, Department of Anatomy, Columbia University.

The extensive fissuration of the liver and the presence of a single papilla in the kidney are characteristics which the gorilla shares with the pronograde monkeys. In contrast to these features is the vermiform appendix, which closely resembles that of man.

26. *Female reproductive system of the gorilla.* Wm. B. Atkinson and Herbert Elftman, Department of Anatomy, Columbia University.

The internal organs of the female reproductive system of the gorilla differ from those of man chiefly in features which are secondary to the contrasts in skeletal morphology. The external genitalia are characterized by the absence of labia majora and the presence of paraurethral glands.

27. *Dermatoglyphics of the gorilla.* Harold Cummins, Department of Anatomy, Tulane University.

This comparison of gorilla with other great apes and with man is based upon a study published in 1942 (Palmar and Plantar Dermatoglyphics in Primates, Charles Midlo and Harold Cummins, Am. Anat. Mem., no. 20). Gorilla shares with other great apes a generally longitudinal alignment of palmar and plantar ridges in the areas undisturbed by local pattern; man differs in presenting alignments which are mainly transverse or diagonal, a condition regarded as less specialized. Pattern intensity, a measure of the degree of expression of localized patterns, in-

creases in this order: Palms — Homo, Pan, Gorilla = Pongo; Soles — Pongo, Pan, Gorilla = Homo. Low pattern intensity is considered an evidence of specialization. In Gorilla and Pan the pattern intensities of palm and sole are essentially equal, in Pongo the palm exceeds the sole by 70%, and in Homo the sole has a value over twice that of the palm. Unlike levels of pattern intensity in palm indicate differential specialization of the two members. Right-left differences are least in Pongo and Homo, greatest in Gorilla. Large bilateral difference is regarded as a sign of specialization. Homo conforms more closely than do the great apes, Gorilla and Pan especially, to the basic mammalian plan of localized patterns. According to this criterion of generalization, or primitiveness, the resemblance between Homo and monkeys is closer than that between Homo and great apes.

28. The hand and foot musculature of catarrhine primates — a phylogenetic survey. William L. Straus, Jr. Department of Anatomy, The Johns Hopkins University.

Many hand muscles are "conservative," being essentially uniform throughout the catarrhines. Others, however, follow definite trends within the catarrhine group as a whole (reduction of contrahentes digitorum, subdivision of common extensor). Some specializations are peculiar to anthropoids and man (extensor pollicis brevis, reduction of deep extensor and of palmaris longus), and others are peculiar to the great apes (reduction of long pollical flexor and of thumb musculature in general). There is no feature peculiar to man. He is, however, decidedly more primitive than the anthropoids respecting the thumb musculature.

The foot muscles exhibit similar proclivities. Many are "conservative." Some pursue common catarrhine trends (formation of a peroneus tertius, independence of flexor digitorum brevis and reduction of its fibular tendon). Other features are peculiar to anthropoids and man (reduction of peroneus digiti quinti, of plantaris and of lateral contrahentes digitorum, grouping of interossei about second toe), others are peculiar to the apes (distribution of long digital flexors, reduction of quadratus plantae), and still others are restricted to man (insertion of peroneus longus, reduction of adductor hallucis). Man is definitely more primitive than the anthropoids respecting plantaris, long digital flexors, and quadratus plantae.

The data presented agree with other evidence which suggests that the hominid and anthropoid lines of ancestry may have been separate even prior to the differentiation of the Hylobatinae.

29. Phylogenetic aspects of suture closure. W. M. Krogman, University of Chicago.

This study suggests a correlation between patterns of skull growth and suture closure on the one hand, and the evolution of the brain in Old World apes, anthropoids and man, on the other. It is based upon the study of over 700 Old World ape and anthropoid skulls (Krogman), about 1000 human skulls (Todd), and upon published accounts of the primate brain.

The growth of the neopallium in fronto-occipital and parieto-temporal areas finds its counterpart in the growth of the skull in occipital, fronto-parietal and temporo-parietal regions with the posterior portion of the skull gradually becoming

actually the larger. Further there is a parallel in the sequence and rate of suture closure: early complete closure of the entire cranial group; early closure of the vault, followed later by the circum-meatal sutures as a group; differential rate of closure in the vault group, the lambdoid suture closing early, with the circum-meatal sutures soon following, from front to back or uniformly; and, finally, the persistence of the lambdoid at the time when the coronal is closing, together with very late patency in the circum-meatal sutures.

30. Ontogenetic aspects of sutures in man. Charles R. Noback, Department of Anatomy, Long Island College of Medicine.

To ascertain the general principles behind the formation and the definitive anatomy of the skull bones and sutures, phylogenetic, ontogenetic and especially experimental studies of these structures are all needed. In this paper the ontogenetic aspects of some anatomical features of the prenatal human skull bones in their relation to the anatomy of the adult bones are discussed.

The margins of bones which in the adult articulate as serrate sutures generally are thin, bony reticular networks (most calvarial bones) during early prenatal life. Peripheral to these reticular margins are detached bony nodules and islands. These islands are most frequently found in those sutures where suture bones are found (calvarium). The persistence and growth of these nodules may explain the formation of many, if not most, suture bones.

A few margins with a peripheral reticular network articulate as squamous sutures in the adult.

The peripheral margins of those bones separated by harmonic sutures in the adult are characterized in the early fetal period by having relatively smooth margins without or with only a slight peripheral bony reticular network (most facial bones). However, some of these bones may articulate as serrate sutures. Whenever a reticular network bordered bone articulates with smooth margined bone, a serrate suture usually forms (calvarial-facial junction).

31. Geographic distribution of human blood factors. Philip Levine. Ortho Research Foundation, Linden, New Jersey.

A considerable impetus to the study of the geographic distribution of blood factors was supplied by the discovery of the Rh factor and its importance in a specific form of selective fetal and neonatal morbidity (erythroblastosis fetalis). Much has been contributed to the early history of man by studies on the distribution of only one set of three allelomorphic genes (O, A, and B). It is significant that studies on M and N have yielded comparatively little information. This was to be expected since only two genes are involved. In view of the complex nature of the Rh factor, it is likely that systematic studies of the distribution of all the variants of the Rh factor will yield far more useful anthropological information. As in the case of the four blood groups, the final theory of the heredity of the Rh-Hr system will emerge from or be confirmed by statistical analysis of such studies.

The most plausible theory is that for each Rh variant there is a corresponding Hr factor, each of which has equal dominance, so that a type of blood lacking

both Rh and Hr does not exist. Fisher's view is that there are several closely linked genes rather than a series of multiple allelomorphs.

The view has been expressed that the Rh factor is responsible for more fetal and neonatal deaths than any other gene definitely known. Because of the morbid effects specifically on heterozygous infants (Rhrh), the stability of the Rh gene in any population is of considerable importance, especially in those races with a high incidence of Rh negative individuals. Levine has demonstrated that the incidence of the hemolytic disease is directly proportional to the percentage of Rh negative individuals in any given population as indicated by the tests with anti-Rh_o serum. The selection against the heterozygous and actually against the less frequent recessive gene has been discussed recently, and most workers believe that the Rh genes are of recent origin so that they have not yet reached a state of equilibrium.

The most striking differences thus far observed are (1) a very low incidence of Rh_1Rh_2 and a very high incidence of Rh_o in colored individuals, (2) a high incidence of Rh_1 individuals among the Hindus and Filipinos, and (3) a low incidence of Rh negative individuals among Indians, Chinese, Japanese, and Filipinos.

32. *An anatomy of general and special utility.* W. Montague Cobb, Department of Anatomy, Howard University.

A product of teaching experience is presented, designed to meet the needs of the varied groups whatever the interest, who require or desire a comprehensive grasp of human anatomy. Outlines of the human figure with skeleton from ventral, dorsal and lateral aspects serve as a uniform background upon which separate anatomical features are portrayed in systematic order. Marginal entries illustrate relevant ontogenetic, phylogenetic, mechanical, functional, clinical and variational considerations. By this means the sum of research upon a particular part is introduced as elementary features are treated. How the student may prepare his own basic outlines according to a canon of proportions developed for the purpose from classical sources is shown. It is believed that through presentation in this manner, information imparted is greater in amount, more quickly acquired and better retained than is possible through other means.

33. *Applied physical anthropology, past, present, and future.* Francis E. Randall, Office of the Quartermaster General, Washington, D. C.

The past investigations and the persons who were associated with them are briefly reviewed. These include earlier studies on population groups and the applications of the analyses to practical problems in terms of clothing and other types of equipment used by mankind as well as a mention of the development of techniques which are applicable to criminal investigation.

More recent studies conducted by the Armed Forces, as well as by industrial groups, on clothing standardization, seating, and spatial analysis of equipment are discussed.

A plea for training of qualified students to enter into the researches which will arise in the future is the concluding aspect of the paper. The need for practical, ethical, and well-trained men and women in the field is real and urgent.

34. Hiatus canalis sacralis in American Whites and Negroes. Mildred Trotter and Patricia F. Lanier, Department of Anatomy, Washington University, St. Louis.

The extent of the hiatus canalis sacralis was studied in a series of 1225 White and Negro bones.

The base of the hiatus lies at the level of the body of the fifth sacral vertebra in 70% and at the level of the body of the first coccygeal vertebra in 29% of the bones examined. When the coccyx is fused to the sacrum 73% present the base of the hiatus at the level of the body of the first coccygeal vertebra. The mean width varies from 15.9 mm in the White females to 17.6 mm in the Negro males. In the Whites but not in the Negroes, there is a tendency for the width of the base to increase as the base is found to be more cephalad.

The hiatus is longer in Whites than in Negroes, in males than in females, and in those sacra where the base lies on a level with the coccyx rather than with the sacrum.

The apex of the hiatus lies at the level of the body of the fourth sacral vertebra in 65% of all the bones; the remaining 45% are approximately equally divided between higher and lower levels. The anteroposterior diameter of the hiatus at its apex is significantly greater in Negroes than in Whites.

This study was aided by a grant from the United States Public Health Service.

35. Russian physical anthropology: a sketch of its history with particular reference to raciology. Earl W. Count. The Viking Fund, New York.

No abstract.

36. Somatotype distributions of disease groups as shown on triangular graphs. C. W. Dupertuis, Presbyterian Hospital, New York.

A method is described by which somatotype distributions can be plotted on triangular coordinates. The distribution of somatotypes in four different disease groups are presented. The cancer of the breast distribution is compared with that of the rheumatoid arthritis series and, for the males, the duodenal ulcer group is compared with gall bladder disease. The cancer of the breast group shows a concentration of somatotypes in which the first and second components are relatively high, with the third component low. The rheumatoid arthritis group, on the other hand, shows less second component and the distribution indicates a bimodality in that there are many cases of relatively high first component and many other cases of relatively high third component. In the ulcer-gall bladder comparison, the ulcers show relatively less first and more third component whereas the gall bladder patients exhibit a relatively higher first component and lower third component. Both these male series show more second component than has heretofore been attributed to them.

37. Current trends in international cooperation. R. L. Zwemer, U. S. State Department.

At the meeting in Philadelphia last year, the American Association of Physical Anthropologists was given a brief survey of the activities in anthropology and re-

lated subjects, as carried out by this Government in cooperation with the other American Republics. These observations are brought up-to-date. Additional information regarding proposed legislation for extending this program on a cooperative basis with countries of the Eastern Hemisphere is discussed. There is also a discussion of these organizations under the Social and Economic Council of the United Nations, which may deal with matters of interest to anthropologists, and of how the American Association of Physical Anthropologists can assist in promoting international goodwill as well as general scientific advancement of all peoples.

The relationship of the United Nations Organizations to nongovernmental scientific groups is discussed, particularly in reference to international conferences.

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MIGRATION AND PHYSICAL DIFFERENTIATION

A COMPARISON OF IMMIGRANT WITH AMERICAN-BORN CHINESE [1]

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ONE FIGURE

PURPOSE

To measure the effect on adult physique of the environment in which individuals are born and reared it is necessary to know, by analogy, what would have occurred in another setting.

By the simple method of controlled experiment definite and marked effects of specific environmental factors on the body form of various species of animals have been recorded. Thus higher temperatures slow the growth of mice (Mills, '42) and influence the length of the tail (Fortuyn, '34). Better diet broadens the head of swine (Basler, '25) but has the opposite effect on rats (Neubauer, '25). I have observed abnormalities in the form of the jaws and other bones in the skulls of monkeys and apes which had long lived in captivity.

In man the problem is more difficult to study and there has been great reluctance to accept the finding that physical traits are dependent on environmental as well as on hereditary factors. In one study Walcher ('05) showed that the cephalic index of babies is increased by their habitually being placed with the head resting on the occiput and is decreased by regularly laying the head on its side. However, Basler ('27) ex-

[1] During the prosecution of the work the author was a teaching fellow in Anatomy at Harvard Medical School. The subject here considered has been previously discussed in the author's doctoral dissertation (Lasker, '45a) and the present material has been abstracted from that source.

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SEPTEMBER, 1946

amined some of the same individuals when they had reached 17 to 20 years of age and found some tendency for the head to return to the original form. In any case, the effects of artificial deformation of the head caused by the cradling and head binding practices of certain peoples are marked and permanent.

Where the environment impinges less directly its effects can be documented only when the individuals are very homogeneous genetically, as in identical twins (von Verschuer, '28 and Gardner and Newman, '40), or when the changes in environment are very marked. One type of radical change in environment occurs during a famine: Ivanovsky ('23) has recorded dwarfing and other physical changes during the great famine in Russia. Another type of marked change in environment has been taking place over the years and to this has been ascribed the increase in size of American students compared with their like-sexed parents (Bowles, '32) or to their predecessors (Meredith, '41), and the year by year increases in the stature of recruits in Sweden, Norway and other countries (Lundman, '40). Such physical changes have been attributed variously to climate, social factors, economic status, hygienic conditions, diet, outdoor life and infant care.

The best opportunity for the study of members of a single racial stock in environments known to be radically diverse is to be found, however, when some members of a community have migrated to another land. Furthermore, the large scale of migration in recent years lends practical significance to studies of the processes involved.

In a pioneer study of this type Fishberg ('05) showed American-born Jews to differ from Jews measured in Europe in respect to stature and, probably, head dimensions.

The classic investigation of the problem is that of Boas ('11) on immigrants to America and American-born offspring of immigrants. He found that in various groups there were changes in different directions. As the differences could not be accounted for by selection, except on the assumption of an improbably complex adjustment of cause and effect, Boas felt compelled to assume that the differences were caused by physi-

ological modifications that had occurred under changed environments, and that head-form may undergo certain changes in course of time without change of descent. Morant and Sampson ('36) recalculated Fishberg's and Boas' data on Jews and found that, after approximate age and sex corrections were made, the American-born children were only barely significantly different from their parents. Subsequent studies on Jews in Boston (Guthe, '18 and Hirsch, '27) and Berlin (Dornfeldt, '42) tend to confirm Boas' findings, however.

There have been a few studies among other population groups. Mills ('42) showed that Panama-born North American children were lighter in weight and slightly shorter in stature than immigrants to Panama of comparable ages. Appleton ('27, '28) measured Chinese children born in Hawaii; these showed a more rapid and steady growth than Chinese she measured in China.[2] Shapiro ('31) has published a preliminary comparison of immigrant and Hawaiian-born Chinese. These differed significantly from each other in stature and other respects which will be considered below, and to an extent which cannot be ascribed solely to the difference in average age.

In an extensive and rigorous recent study of the problem, Goldstein ('43) has examined Mexican parents and their offspring born in Mexico and the United States. He demonstrated many significant differences between adult American-born Mexicans and their like-sexed immigrant parents. In general the American-born differed in the same way but to a lesser extent from individuals of the same age born and raised in Mexico as from their own parents.

The most thoroughly studied group of migrants are the Japanese. Among children, Iyenaga and Sato noted in 1911 that 7- to 16-year-old Japanese in twenty California schools were larger than children of the same ages in Japan. Kanjakai ('21) (according to Tsai, '35) found that children born of Japanese parents in California were 2 inches taller and 30

[2] The former were of Cantonese extraction, the latter were East Chinese and hence not strictly comparable.

pounds heavier than children born in Japan. Spier ('29) compared Japanese children in Seattle with those in Japan and found the former to exceed the latter in stature, head width, cephalic index and, in most cases, head length. In a study of American-born Japanese boys and girls Suski ('33) found his measurements to exceed those of the Japanese Ministry of Education in height, weight, chest circumference and relative leg length. Other studies giving similar results are quoted by Ito ('42).

Data on Japanese adults indicate that the eventual stature as well as the growth process are affected by environment. The differences noted in the children therefore cannot be ascribed to a mere delay in the reaching of the appropriate size for the race. Adams ('37) noted that sons of Japanese immigrants to Hawaii tend to be taller than their fathers. Suski ('33) reported that 100 American-born Japanese youths 19 to 22 years of age exceeded their fathers in weight by 6% and in height by 5% (more than 3 inches). Ito ('42) found that American-born women of Japanese descent who remained in America exceeded those who went to Japan when young and, even more markedly, exceeded those born in Japan in respect to stature, sitting height, trocanteric height, span and biacromial diameter, while the reverse relationship held for thoracic circumference, body weight, relative sitting height and relative span.

The most adequate study of the problem on Oriental immigrants is Shapiro's ('39) investigation of Japanese immigrants to Hawaii, their offspring and related individuals born, raised and remaining in their land of origin.[3] Nearly 2,500 individuals were examined. The Hawaiian-born were significantly larger than the immigrants in stature, head width and lengths of the trunk and members, but smaller in nose width and total facial height. In most of these characteristics the differences were present for both sexes and various regional and age groups. Furthermore, Shapiro found the American-

[3] Shapiro has coined the word "sedentes" for these and I shall use it in his sense.

born to differ even more markedly from the sedentes in many of these same respects.

Shapiro and others have thus demonstrated a definite, though limited, plasticity in one people with a particular change in milieu. The finding suggests the possibility that other Oriental populations in similar circumstances undergo similar changes. In the hope of learning whether such changes occur in another group, and whether the direction and extent of change are similar or not, I undertook the study of Chinese in America.

MATERIAL

It has been noted that one of the chief criticisms of Boas' study is the difference in age of the groups compared (Morant and Sampson, '36). This problem also arises in connection with Shapiro's studies, especially in his study of Chinese in Hawaii, for there had been virtually no new immigration to Hawaii for several decades and the only immigrants available for study were old people. In the Chinatowns of eastern United States, however, one finds American-born Chinese in the minority and the immigrants have been coming from the same small area in China for over half a century.

Writing in 1887, Culin gave an accurate description of the areas in China whence laborers had come to the cities of eastern United States. He found that the immigrants, nearly all agriculturalists with a sprinkling of artisans and with very few city dwellers from Canton, came from an area of little more than 100 miles square in the departments of Kwangchou and Shangking in Kwangtung Province. "They describe themselves as Punti or 'natives' as distinguished from the tribes called Hakka or 'strangers' and divide themselves into the people of Sam Yup ('Three Towns') and those of Sz' Yup ('Four Towns') . . . and there are a few each from Tungkwan, Hiangshan [Chung Shan], Sanshwui and Sinngan." He found, moreover, that the people of Hoksan include themselves with the "Four Towns" (really counties), and that the greatest part of the immigrants had come from the maritime district of one of the "Four Towns," Sinning (now called


KWEICHOW
KWANGSI
HUNAN
KIANGSI
FUKIEN
KWANGTUNG
A.
B.
CANTON
SWATOW
HONG KONG
TONKIN
ANNAM
HAINAN
MAP OF
KWANGTUNG PROVINCE
CHINA
1. NANHAI
2. P'ANYÜ
3. HSUNTE
SAN YÜ
4. HSINHUI
5. T'AISHAN
6. K'AIP'ING
7. ENP'ING
SZE YÜ
8. HOSHAN
9. TUNGWAN
10. CHUNGSHAN
11. SANSHUI
12. HSINAN
A. CHAOCH'INGFU
B. KUANGCHOUFU

Figure 1

T'ai Shan). Culin's account might almost as well refer to today. Recent immigrants as well as American-born Chinese trace their origin to the same villages. These people, who will hereafter be referred to as "Cantonese," all speak the same language (except for a few Hakka for whom it is a second language) but with slight differences in dialect.

Though Chinese are very suitable for a study of the present kind, in that there has been a steady flow of migration to a sharply contrasting environment from a single restricted region, there are several respects in which Chinese are less ideal subjects. The extreme rarity of Chinese women in America, as well as the attitude towards these women, makes a study of females impracticable. The scarcity of females may have introduced a selective factor insofar as the wealthier immigrants are more likely to have secured wives and fathered sons in America. Furthermore, it is frequently difficult to get accurate information about Chinese subjects. Legal immigration virtually ended with the passage of the Chinese exclusion act of 1882, and consequently many Chinese are reluctant to give information about name, age and place of origin.

In the present study only males were examined. Of the 284 adult individuals measured, 97 were Cantonese immigrants, 48 were American-born of Cantonese extraction, 5 were Hawaiian-born, 9 Cantonese were born elsewhere, and the rest were from other parts of China. I made all the measurements and observations, working in Cambridge, Boston, New York and other cities of eastern United States as opportunity afforded between November, 1940 and May, 1942.

Birthplace was ascribed to as fine a geographical unit as possible and the birthplace of grandparents as well as parents was almost always known and recorded. Occasionally such leading questions as "Near Canton?" or "Hoisan?" (the local pronunciation of T'ai Shan) were asked, but it is believed that the responses were reliable. In a few cases the American-born showed some hesitancy about naming the birthplace of their mothers but for the most part mothers and fathers must have come from the same counties. The grandparents of the Amer-

ican-born and the grandparents of the immigrants were born in the same few counties in south-central Kwangtung: 65% of the former and 72% of the latter were natives of the "Four Towns," most frequently T'ai Shan.

Among 94 of the Cantonese immigrants, 41 were students, 29 were employed in laundries, 17 in restaurants and the rest in various occupations. Of 46 of the American-born, 33 were students while only 1 each were employed in a laundry and a restaurant and the rest were variously engaged. These data indicate a slight tendency to diversification of employment in the American-born, but the higher percentage of American-born in school is in part the result of a slightly lower average age as well as altered social status.

METHODS

The methods of measurement of Martin ('28) were followed without significant modification with the following exceptions. Weight was taken with a spring scale which was not very accurate. Limb measurements were taken on the left side. The arm was measured from the anterior border of the acromial process with the limb extended in front of the subject, a method giving a smaller dimension than the Martin technique. The same position was used in the measurement of the segments of the arm. Tibial length was taken with the subject sitting and the left ankle supported on the right knee. Femoral length was omitted from the schedule because of the difficulty of accurately locating the greater trochanter. Hand breadth and foot breadth were taken from the medial border of the first to the lateral border of the fifth metacarpo-phalangeal and metatarso-phalangeal joints respectively. All subjects were examined with their trousers on which may account in part for the unduly high figures for bi-iliac diameter. Chest measurements, particularly depth, were difficult to take accurately. Projected measurement of head height was taken with the anthropometer and is not very accurate. It appears probable that I have located nasion slightly above the bony nasion to judge from a check of nasal and facial heights with skeletal

material; however, the deviation is probably constant and not greater than in most previous studies of living Chinese. In measuring nasal breadth I have used care not to compress the nasal wings in consequence of which my measurements tend to be greater than those of other investigators. The nasal salient was measured by projection.

In subjective observations, the methods of the Harvard Anthropological Laboratory were usually followed. In general the attempt was made to take the average condition in Northwest European males as a standard. For skin color the von Luschan scale was used and, though the skin color of Chinese cannot accurately be matched on the scale, it was possible to distinguish lighter from darker shades.

RESULTS

Measurements (table 1)

Body as a whole. There is a suggestion that American-born Chinese tend to be slightly heavier than immigrants. The stature of Chinese born in America is significantly greater than the stature of immigrant Cantonese.

Limbs. American-born Chinese considerably and significantly exceed immigrant Cantonese in respect to span, total arm length, upper arm length, lower arm length, tibial length and foot length. The tendency to greater lengths in the American-born seems to be approximately the same in various long bones. The leg length (stature less sitting height) is greater by the same amount as the arm length. Though hand length shows no appreciable difference, the American-born Chinese have significantly broader hands than the immigrants. The immigrants in turn have broader hands than any other group of Chinese I have measured. The foot breadth is not differentiated; and, unlike the hand, the foot shows a significantly greater relative length in the American-born.

Torso. The sitting height and biacromial and bi-iliac diameters in the American-born Chinese are somewhat, but not significantly, greater than in immigrants. The relative shoulder breadth and the shoulder-hip index show no differentiation.

TABLE 1

Measurements and indices on immigrant and American-born Chinese.

	AMERICAN-BORN CHINESE			IMMIGRANT CHINESE			DIFFERE[NCE]
	Mean	σ	Range	Mean	σ	Range	Mean
Number	48			97			
Age (years)	23.0	4.4	18–42	27.7	8.0	18–60	— 4.64
Age at migration (years)				17.0	5.0	1–33	
Weight (lbs.)	131.8	13.4	104–162	128.8	21.7	96–240	2.95
Stature (mm)	1676.3	51.7	1593–1797	1655.6	54.1	1513–1766	20.69
Sitting height	895.0	26.3	844–956	888.0	30.6	811–946	6.99
Span	1734.8	62.0	1624–1875	1705.5	62.0	1561–1856	29.80
Total arm length	711.8	30.9	642–778	698.1	27.6	621–754	13.64
Upper arm length	292.2	17.0	250–335	285.6	15.0	242–316	6.62
Lower arm length	250.4	11.8	227–276	243.1	11.9	216–268	7.27
Hand length	186.1	8.1	168–207	185.1	8.2	165–201	1.04
Hand breadth	81.2	2.7	77–88	79.4	4.5	71–91	1.75
Lower leg length	369.2	17.8	330–412	362.6	14.3	330–400	6.53
Foot length	255.9	9.7	238–279	249.4	10.3	226–270	6.47
Foot breadth	97.3	4.6	85–109	97.1	5.0	85–110	.26
Biacromial diameter	391.4	16.8	361–430	387.6	17.5	346–444	3.80
Biiliac diameter	288.3	17.3	242–347	283.1	20.2	238–375	5.18
Chest breadth	276.5	13.3	255–303	273.1	22.9	222–389	3.38
Chest depth	198.2	16.9	157–257	201.5	18.4	167–288	— 3.27
Head length	187.2	7.1	177–202	188.4	5.9	175–204	— 1.21
Head breadth	154.8	5.2	143–170	153.3	5.1	139–166	1.55
Head height	129.0	5.3	116–139	130.5	4.9	121–142	— 1.48
Minimum frontal diameter	102.6	4.6	92–113	102.2	4.7	92–117	.41
Bizygomatic diameter	142.2	5.2	131–155	141.1	5.7	124–155	1.12
Bigonial diameter	107.3	5.2	96–120	106.9	6.0	93–120	.40
Interocular diameter	32.3	3.2	27–42	32.4	2.7	25–39	— .10
Total facial height	124.6	6.2	113–136	121.8	5.3	109–134	2.72
Upper facial height	73.5	4.8	64–83	73.2	4.5	59–85	.21
Nose height	55.5	3.0	49–62	53.4	3.4	45–61	2.13
Nose breadth	40.4	2.1	35–47	40.5	2.5	35–49	— .09
Nose salient	22.9	2.0	18–25	22.5	2.3	16–28	.40
Relative span	103.48	1.82	99–108	103.02	2.16	97–108	.46
Relative shoulder breadth	23.49	.79	22–25	23.41	.82	21–25	.08
Shoulder-hip index	73.34	4.12	64–88	73.11	4.27	63–86	.23
Thoracic index	71.71	5.39	60–86	73.77	5.10	65–91	— 2.06
Relative sitting height	53.44	1.23	51–56	53.64	1.16	51–57	— .20
Cephalic index	81.80	4.08	72–91	81.42	3.31	72–93	.38
Length-height index	68.20	2.75	63–74	69.30	2.91	63–78	— 1.10
Breadth-height index	83.38	3.97	76–92	85.21	3.85	78–96	— 1.83
Fronto-parietal index	66.44	2.83	59–74	66.71	2.85	60–74	— .27
Cephalo-facial index	91.76	2.41	87–97	92.00	3.11	84–98	— .24
Zygo-frontal index	72.52	3.39	60–82	72.54	3.38	66–86	— .02
Fronto-gonial index	104.54	6.47	92–130	104.75	6.61	88–121	— .21
Zygo-gonial index	75.52	3.16	68–82	75.81	3.51	67–86	— .29
Total facial index	87.12	4.61	78–96	86.47	4.57	76–105	.65
Upper facial index	51.90	4.23	45–64	51.98	3.61	41–66	— .08
Nasal index	73.11	5.52	58–84	76.29	7.02	61–96	— 3.18
Nose salient-height index	40.76	3.77	33–51	42.34	4.47	30–54	— 1.58
Brachial index	84.09	4.55	74–96	85.20	4.10	74–95	— 1.11
Hand length-breadth index	43.64	1.57	41–48	43.73	1.67	39–50	— .09
Foot length-breadth index	38.05	1.34	35–42	38.85	1.80	36–43	— .80

[1] The difference is more than four times the probable error of the mean.
[2] The difference is more than three times the probable error of the mean.

The mean width of the chest in American-born Chinese tends to be greater than in immigrants, though there were several individuals in the latter series who had extremely wide chests. Unlike all other measurements so far considered, the tendency is for chest depth to be smaller in American-born Chinese. The thoracic index is, correspondingly, significantly higher in immigrants.

Head. Compared with Cantonese immigrants, the head length of the American-born is slightly, but not significantly, smaller. The head is broader, however, by an amount equal to two and one-half times the probable error of the difference. The head height apparently tends to decrease in American-born Chinese, but the interpretation of the decreases in length-height and breadth-height indices, though statistically significant, is in doubt because the height measurement is only approximate.

Face. American-born Chinese have slightly broader faces (bizygomatic diameter) than immigrants. They are not distinguished from immigrants in respect to interocular and bigonial diameters, but they have a significantly greater total facial height and a tendency to greater upper facial height. American-born Chinese have a significantly greater mean nasal height than immigrants but, if anything, very slightly narrower noses. The nasal index is therefore significantly greater in the former.

Observations [4] *(table 3)*

Skin color. A comparison of American-born Chinese with immigrants shows only one statistically significant difference, the immigrants more frequently have shade no. 9 on the upper arm. There is a general tendency both for darker exposed and darker protected skin to be found more often in the American-born. A complicating factor in skin color determinations is the effect of tanning. The forehead was darkest

[4] Observations on the teeth in these series (caries, loss, attrition, bite, crowding, eruption of third molars and shovel-shaped incisors) have been previously reported and discussed (Lasker, '45a, '45b).

in individuals examined in July, August and September, and the inner aspect of the arm was darkest in individuals seen in August, September and October. It is clear that the effects of exposure to light are so great as to outweigh other factors which might cause minor differences in skin color among persons of similar heredity.

A few individuals were examined by the scratch test for vascularity. They showed a variable degree of reactivity.

Hair. There is no evidence of environmental effects on the hair form. More likely the occasional presence of a tendency to wave in the hair of South Chinese is to be attributed to the survival of the descendants of unions between Chinese and the aboriginal peoples of the region or to the migration to this part of China of the half-Chinese offspring of Malay mothers.

There was a slight tendency towards coarser hair in the American-born Chinese. This observation should be tested by the accurate measurement of hair diameter.

Almost all Chinese have black hair. Only very few adults have hair which when examined by transmitted light shows a little reddish or brownish color. The greater frequency of gray hair in immigrant Cantonese may reflect merely the slightly higher percentage of older individuals among them.

Typical pattern baldness of the crown is rare in Chinese. However, a tendency for the forehead line to recede was not uncommonly observed, particularly in the immigrants. Presumably, as in the case of gray hair, this is related to the somewhat greater average age of the immigrants.

In general the American-born Chinese appeared to be slightly more hairy than the immigrants. Without counting hairs, but judging from impression, the head hair of Chinese, American-born Cantonese particularly, appeared dense. Chinese showed little development of hair on the forearm or the second phalanges of the fingers. In both these locations there was a tendency to somewhat greater hairiness in the American-born. The eyebrows showed little lateral extension in the Chinese but significantly less in the immigrant than in the American-born. Also in concurrency of the eyebrows the

American-born Cantonese showed more development. The density of the beard in Chinese is progressive with age and appeared to be more ample in the immigrants than in the American-born.

Eye color. The iris color of the Cantonese, when illuminated with a flashlight, ranged from those so dark that no pattern was discernible in the iris ("absolute dark") to those where a faint line of greenish color — not to be confused with arcus senilis — was to be seen in the outer zone of the iris ("nearly dark"). Intermediate eyes of brown color with an evident pattern ("pure dark") were the most frequent type. The lighter shade of eyes occurred more frequently in American-born Chinese and was also present in three of the five Hawaiian-born Chinese I examined.

The sclera tended to be less frequently pigmented in the American-born Chinese.

Region of the eyes. The thickness of the eyelid is always rather pronounced in Chinese. Furthermore there is either an internal or a complete Mongoloid eyelid fold in most individuals. In both eyelid thickness and eyefolds less variability was recorded for the American-born Chinese, the majority of whom had an internal epicanthic fold.

As is so frequently averred by laymen, the palpebral opening is usually narrow in Chinese and the eye obliquity is usually upwards. The foreign-born Chinese were not distinguishable from immigrants in these respects.

The front of the eye appears to protrude in reference to the surrounding structures more than in most races. Associated with this is a tendency to flatness of the external angle of the orbit. In these, as in other traits pertaining to the conformation of the region of the eye, there were no significant differences between the American-born and the immigrant Chinese.

Forehead. The forehead height and slope of Chinese immigrants and American-born were highly similar. The majority of Chinese have small browridges. Cantonese born in America showed a percentage distribution of the trait similar to immigrants.

Nose. The nose of Chinese is generally low and broad both at the root and the bridge. There is relatively little depression of nasion. The septum is usually straight at its free margin. Compared to the immigrant Cantonese the American-born Chinese showed less nasion depression, fewer very broad roots, more variable bridge breadths and profiles, more narrow nasal tips, fewer flaring nasal alae and fewer noses with pronounced frontal visibility of the nostrils. In American-born Chinese the part of the nose supported by bone was relatively more frequently convex. A distinct projection of the nasal tip occurred in about half the Chinese I examined. This was seen most often in individuals with a convex bridge profile and was more common in American-born than in immigrant Cantonese.

Lips. The integumental part of the lips tends to be well developed and the membranous portion is usually thick and delimited by a well marked lip seam in Cantonese. In none of these respects were the American-born differentiated.

Chin. The chin of Chinese, more often retreating than prominent, is rarely of the bilateral type. Immigrants were not different from American-born in respect to chin type.

Ear lobes. The ear lobes in Chinese tend to be of medium size and usually hang free. The immigrants were not significantly different from the American-born.

Malar region. The malars of Chinese usually project markedly both laterally and frontally. The Cantonese immigrants were slightly more variable than the American-born in the degree of lateral development of the region.

Occipital flattening. Most Cantonese have well rounded occiputs but about one-third of both immigrants and American-born showed a slight or moderate flattening. There is, however, no clear evidence of intentional artificial head deformation.

Sagittal crest. Keeling of the skull, often thought of as a Chinese trait, was absent in the majority of Cantonese, both immigrant and American-born. When a sagittal crest was palpated it usually was not well developed.

Torus palatinus. Torus palatinus, as judged without palpating, was significantly more frequent in American-born than in immigrant Cantonese. It also occurred in four of the five Hawaiian-born Chinese I examined.

DISCUSSION

In the measurements the most notable differences between American-born and immigrant Cantonese lie in the greater size of the former. In respect to all trunk and limb measurements (except chest depth) the American-born Chinese are larger than the immigrants, and in half of these linear measurements the difference is statistically significant. On the other hand among the measurements of the head and face only total facial height and nose height show statistically significant differences.

The physical differences between immigrant and American-born Chinese probably are caused by some differences in the changed environment. As several factors in the diet are altered [5] and as there are also some differences in climate and in habits, one cannot determine exactly which elements are involved. It is notable, however, that those measurements which are greater in the American-born are all highly correlated with each other and that a single factor which I would call an "environmental size factor" suffices to explain the observed phenomena.

As stature is considerably greater in American-born than in immigrant Cantonese, one may use the degree of correlation with stature as an index of the "environmental size factor." Those dimensions with the highest positive correlation with stature are most notably increased in the American-born while low or negative correlation with stature are in no case significantly increased. Stevenson ('40), using a large series of North Chinese, has calculated the coefficient of correlation with stature of twenty-four of the twenty-eight measurements

[5] Chinese in America probably receive more calcium, proteins and vitamins A, D, ascorbic acid and thiamin. Some of these food elements may be inadequate in the diet of many persons in Kwangtung Province (Lasker, '45a, '45b).

considered in this study, and at least the rank order of Stevenson's coefficients is more or less representative for Chinese. Tcheboksaroff ('35) gets very similar results for those of the coefficients he has calculated. All four traits which show a tendency to be smaller in American-born Chinese are among the half of the traits with the lowest correlations with stature. Of the six traits which show a correlation with stature of less than 0.2, none shows a significant tendency to be greater in American-born than in immigrants. The only trait negatively correlated with stature, nose breadth, is one of the few traits which tends to decrease in the American-born. Only three measurements of the head and face — bizygomatic diameter, face height and nose height — have a correlation with stature above 0.2 and all tend to increase in the American-born; the last two being the only head and face measurements which are significantly greater in American-born Chinese.

This environmental size factor which is identified in the measurements of the present series probably has wider applicability. At least the general trend of the differences I have observed can be paralleled in other data, particularly those of Shapiro's ('31) study (table 2).

The greater stature of American-born Chinese corresponds to the findings among Chinese in Hawaii. Wissler ('30), Appleton ('27) and Shapiro ('31) have previously reported an average stature for Hawaiian-Chinese greater than in Shapiro's series of immigrants to Hawaii or Li's ('28) or my series of immigrants to mainland United States.

Studies in Kwangtung give a lower mean structure than for emigrants. Stevenson ('25) reported a mean of 1646 to 1662 mm for each age class from 17 through 22. Keys and Cadbury ('26) reported a stature of 1655 mm for 173 students aged 18 to 20. All other adequate series of individuals from Kwangtung Province show a smaller stature [6] with the exception of a

[6] Shirokogoroff ('25), 220 prisoners — 1613 mm and 110 workmen 1603 mm; Hutcheson ('20), 232 individuals — 1608 mm; Basler ('31–'32), 52 students — 1648 mm; Cadbury ('24), 110 students — 1636 mm; Whyte ('18), 1,021 patients at Swatow — 1627 mm; Kulp ('32), 92 individuals at Swatow — 1644 mm; Uttley ('42), 11,849 Cantonese prisoners at Hongkong — 1631 mm; and Hagen, 15,582 coolies in Sumatra — 1622 mm.

TABLE 2

Mean measurements and indices on Chinese of Kwangtung Province at home and abroad (according to various authors).

	HAWAIIAN-BORN	IMMIGRANT	IMMIGRANT	SEDENTE
Author	Shapiro	Shapiro	Li	Shirokogoroff
Number	62	28	27	330
Age (years)	24.7	52.3	28.4	
Stature (mm)	1663	1645	1655.5	1609.3
Sitting height				840.6
Total arm length				712.0
Upper arm length				301.7
Lower arm length				230.4
Hand length				179.9
Head length	187.6	186.0	187.7	185.2
Head breadth	152.4	151.5	151.4	148.0
Head height	129.8	128.2	125.2	131.5
Minimum frontal diameter	110.5	110.1	107.0	103.1
Bizygomatic diameter	141.6	141.5	141.1	137.9
Bigonial diameter	109.2	106.6		105.3
Interocular diameter	34.2	33.3		34.0
Total facial height	120.3	117.4	120.0	112.5
Upper facial height	68.9	66.2		
Nose height	51.8	48.7	50.8	40.0
Nose breadth	39.8	40.3	36.3	37.0
Nose salient	17.8	18.4		
Relative sitting height				52.24
Cephalic index	81.41	81.32	80.54	79.97
Length-height index	69.21	68.90	66.76	71.06
Breadth-height index	85.11	84.68	82.71	89.00
Fronto-parietal index	72.59	72.78	70.68	
Cephalo-facial index	92.93	93.22	93.22	
Zygo-frontal index	78.11	77.94	75.93	
Zygo-gonial index	75.30	77.31		76.64
Total facial index	85.09	83.12	84.97	81.59
Upper facial index	48.69	46.89		
Nasal index	76.94	83.17	76.28	93.58

series of students measured at Hongkong by Crook.[7] It is clear that Chinese immigrants in Hawaii and America are taller than sedentes but are significantly exceeded in height by American-born and Hawaiian-born Chinese. This cannot be

[7] Crook ('08) found 115 individuals to average 1663 mm in stature. The ten immigrants from Hongkong measured in the present study averaged 1697 mm, nearly 5 cm taller than the rest of the Cantonese immigrants.

explained on the basis of regional differences within Kwangtung, for the peoples who speak the Hakka, Punti and Hoklo dialects are not markedly different. Nor can it be explained adequately on the basis of class differences, though it must be borne in mind that there are considerable differences in the stature of Chinese associated with social status, students tending to be tallest, prisoners and coolies generally shortest.

In sitting height the very low figure reported by Shirokogoroff ('25) for sedentes is probably caused by personal divergencies in his method of taking the measurement. Likewise Shirokogoroff consistently reports figures for the radial length approximately a centimeter less than other investigators working on comparable groups. Furthermore his higher figures for total arm length and upper arm length must be ascribed to the difference between his and my methods of taking the measurements.

Previously reported data on head measurements are in general agreement with the present results. Other measurements of Cantonese in America by Li and in Hawaii by Shapiro show approximately the same head length though among males Shapiro found a tendency for the immigrants to have shorter heads. Cantonese sedentes appear to have somewhat shorter heads.[8] In head breadth the American-born Cantonese of the present study not only exceed my series of immigrants, but both these series exceed in head breadth the figure for Cantonese immigrants reported by Li. The latter is very closely comparable to Shapiro's series of immigrants to Hawaii, and the Hawaiian-born have slightly broader heads. Sedentes measured by Shirokogoroff have narrower heads than any of the previously mentioned series. In head height the tendency we noticed towards decrease in the American-born was considered untrustworthy because of the inaccuracy of the method of measurement. Shapiro's finding of the contrary tendency in Hawaii emphasizes the necessity of deferring judgment

[8] This is true for the data given by Shirokogoroff ('25) and for Hagen's series of Chinese in Sumatra. Chuan's ('20) published figure of a mean head length of 198 mm for fifty individuals appears to be an error.

pending the collection of adequate data by trustworthy techniques. In the case of the minimum frontal diameter various investigators appear to introduce a large personal equation. Similarly to the present study, in Shapiro's — where all individuals were measured by the same worker — there is no appreciable difference between immigrants and Hawaiian-born.

In the facial measurements the tendencies noted for Chinese in America are in general paralleled in Hawaii. This is particularly true for the total facial height and nose height (where marked increases are recorded in the foreign-born) and in nose breadth (where there is a slight tendency to decrease in the foreign-born). In respect to bizygomatic diameter the American-born show more tendency to increase whereas in bigonial diameter and upper facial height the Hawaiian-born show more tendency to increase (though Hawaiian-born females tend to decrease in these respects). Interocular diameter shows, if anything, a slight tendency to decrease in the American-born and a tendency to increase in the Hawaiian-born. For nose salient the reverse is true. Li's series of Cantonese immigrants is intermediate between Shapiro's two Hawaiian series in respect to total facial height and nose height and is smaller than either of my series though more similar to the immigrants in these respects. In bizygomatic diameter and nose breadth, Li's series is smaller than any of Shapiro's or the present series.

Shirokogoroff's series of Cantonese sedentes has a smaller mean face size than any of the series of overseas Chinese, at least in reference to bizygomatic diameter, bigonial diameter, total facial height, nose height and nose breadth. The very small figures Shirokogoroff reports for nasal height or length (he uses the terms interchangeably) are probably not only caused by the location of nasion at too low a level but also by his having measured to the nasal tip rather than to the subnasal point (Mahalanobis, '28). The facial as well as the nasal height would be lessened by Shirokogoroff's way of locating nasion.

TABLE 3

Percentage frequency of various observations on immigrant and American-born Cantonese.

	ABSENT		VERY SUBMEDIUM		SUBMEDIUM		MEDIUM		PRONOUNCED		VERY PRONOUNCED	
	Imm.	Am.	Imm.	Am.	Imm.	Am.	Imm.	Am.	Imm.	Am.	Imm.	Am.
Gray hair	75.3	79.2	12.4	16.7	10.3	4.2	1.0		1.0			
Baldness	56.7	70.8	20.6	22.9	17.5	6.2	2.1		3.1			
Head hair quantity					4.5		53.6	43.8	42.3	56.2		
Beard quantity	7.2	10.4	58.8	62.5	30.9	25.0	3.1	2.1				
Lower arm hair quantity	28.9	12.5	36.1	35.4	30.9	41.7	4.1	10.4				
Hair on second phalanges	90.7	77.1	2.1	4.2	6.2	6.2	1.0	12.5				
Eyebrow lateral extension	9.5	8.3	3.2		50.5	35.4	30.5	41.7	6.3	14.6		
Eyebrow concurrency	69.1	47.9	3.1	2.1	19.6	39.6	7.2	10.4	1.0			
Sclera color	44.3	54.2			28.9	31.2	23.7	12.5	3.1	2.1		
Eyelid thickness							18.6	6.2	67.0	85.4	14.4	8.3
Palpebral opening					60.8	62.5	37.1	31.2	2.1	6.2		
Depression of the eye	7.2	14.6			63.9	62.5	27.8	22.9	1.0			
Orbital margin angularity	17.5	20.8			53.6	43.8	25.8	35.4	3.1			
Brow ridges	5.2	2.1	3.1		56.7	58.3	27.8	39.6	7.2			
Forehead slope	15.4	14.6			33.0	39.6	40.2	45.8	10.3			
Forhead height					19.6	20.8	52.6	50.0	27.8	29.2		
Nasion depression			4.1	12.5	30.9	39.6	44.3	37.5	16.5	10.4	4.1	
Nasal root height			33.0	31.2	61.9	58.3	5.2	10.4				
Nasal root breadth					2.1		11.3	25.0	57.7	58.3	28.9	16.7
Nasal bridge height			21.6	29.2	71.1	62.5	7.2	6.2		2.1		
Nasal bridge breadth						2.1	9.3	10.4	73.2	75.0	17.5	12.5
Nasal tip profile	52.6	43.8	6.2	2.1	16.5	16.7	19.6	35.4	5.2	2.1		
Nasal tip breadth					10.3	16.7	58.8	64.6	26.8	16.7	4.1	2.1
Nasal wing flare							49.5	68.8	50.5	31.2		
Nostril angularity						2.1	17.5	14.6	60.8	56.2	21.6	27.1
Lateral visibility of nostrils	6.2	6.2			52.6	39.6	38.1	50.0	3.1	4.2		
Frontal visibility of nostrils	12.4	12.5			25.8	33.3	38.1	43.8	23.7	10.4		
Integumental lip thickness					7.2	6.2	58.8	62.5	34.0	31.2		
Membranous lip thickness					2.1		39.2	39.6	48.4	52.1	10.3	8.3
Lip seam	2.1				15.5	14.6	36.1	35.4	46.4	50.0		
Chin prominence					50.5	39.6	45.4	58.3	4.1	2.1		
Ear lobe size					25.8	16.7	37.1	43.8	37.1	39.6		
Lateral projection of malars					2.1	2.1	24.7	18.8	57.7	72.9	15.5	6.2
Frontal projection of malars					4.1	8.3	37.1	22.9	58.8	68.8		
Occipital flattening	68.0	64.6			16.5	29.2	15.5	6.2				
Sagittal crest	60.8	54.2			32.0	31.2	7.2	12.5		2.1		
Torus palatinus	89.4	43.8			8.5	18.8	2.1	20.8		16.7		
Wave of hair	80.4	81.2	8.2	6.2	11.3	10.4		2.1				
Coarseness of hair					3.1	2.1	18.6	8.3	78.4	89.6		

TABLE 3 (*continued*)

Percentage frequency of various observations on immigrant and American-born Cantonese.

	Imm.	Am.	Imm.	Am.	Imm.	Am.	Imm.	Am.	Imm.	Am.	Imm.	Am.
von Luschan scale	no. 8 and no. 9		no. 10		no. 11 and no. 12		no. 13, no. 14, and no. 15		no. 16		no. 17, no. 18, no. 21 and no. 22	
Forehead skin color			1.0	2.1	3.1	8.4	66.0	47.9	20.6	27.1	9.3	14.6
Arm skin color	24.7	14.6	48.5	45.8	23.7	33.3	3.1	6.3				
	Down		Absent		Submedium Up		Medium Up		Pronounced Up			
Eye obliquity	8.2	8.4	4.1	10.4	30.9	27.1	42.3	45.8	14.4	8.3		
	Absent		Internal		External		Complete					
Eyelid folds	17.5	12.5	47.4	62.5	3.1		32.0	25.0				
	Concave		Straight		Convex							
Nasal bridge profile	21.6	29.2	55.7	31.2	22.7	39.6						
Nasal septum profile	9.3	2.1	57.7	64.6	33.0	33.3						
	Absolute dark		Pure dark		Nearly dark							
Iris color	10.3	8.3	80.4	72.9	9.3	18.8						
	Black		Dark brown									
Hair color	84.4	81.2	15.6	18.8								
	Median		Bilateral									
Chin type	80.4	87.5	19.6	12.5								

In the case of hand breadth the significantly greater size in the American-born Chinese may not be ascribed entirely to the same size factor as most other measurements. A comparison with other series of Chinese suggests that an "occupational factor" may be operative. Wagenseil ('33) reported 38 of 98 non-coolies to have narrow hands whereas only 13 out of 67 coolies had narrow hands. The relationship between occupation and hand breadth may not be a direct causal one for, among Chinese college students in Moscow, Tcheboksaroff ('35) found the average hand breadth of sons of laborers to be significantly greater than that of the sons of either the intelligentsia or the bourgeoisie. Furthermore, there is little to suggest that the American-born Chinese are accustomed to greater manual labor.

The females whom Shapiro studied show the same distinction as the males except that in the Hawaiian-born the head and facial heights tend to be lower rather than higher than in immigrants. The five Chinese born in Hawaii whom I measured resemble my American-born series more closely than they resemble the immigrants. They exceed the latter in virtually all limb and trunk measurements but not in head and face diameters.

For non-Chinese migrant groups, too, something akin to the "environmental size factor" seems to be operative. Shapiro's ('39) study of Japanese in Hawaii shows that most of the differences noted for American-born and immigrant Chinese also hold for other similar racial groups. Thus, of the body and trunk measurements, the Hawaiian-born male Japanese exceed the immigrants in all but the chest depth and breadth and the bi-iliac diameter, and only in the case of chest depth is there a significant decrease. The tendencies reported for Japanese females in Hawaii and continental United States by Shapiro ('39) and Ito ('42) respectively fail to show a close analogy to those of the Chinese males of the present study.

Goldstein's ('43) study of Mexican immigrants to Texas shows results with some points of similarity to those on Chi-

nese. The Mexican immigrant parent tends to exceed his like-sexed American-born offspring in all head and face measurements. In stature and hand length and breadth (the only limb measurements reported) the American-born tend to exceed their immigrant parents, however.

Furthermore, Andrews ('43) called attention to the striking resemblance of the trends reported by Shapiro for Japanese in Hawaii, by Bowles ('32) for college students in New England and the difference he finds for Central Thai compared with the West Lao of Siam. Andrews says: "The pattern consists of generally increased body size — greater stature and proportionately greater weight — with slightly more than proportionate lengthening of arms and legs, relatively broader shoulders and chest, relatively narrowed hips and relatively shallower chests." The most striking difference between the various trends and those of Chinese in America is in the pelvic breadth. This may be partly caused by the somewhat unsatisfactory nature of the measuring technique. Andrews' careful review of the possible factors involved suggests that there may be a secondary factor in addition to increased diversity of diet. He says:

> It is scarcely to be doubted that general size of the body is partially dependent on diet, and that both the variety and quantity of foods ingested are important. It seems reasonable to suppose that when a diet becomes more varied it is less likely to be deficient in any of the vitamins and other elements which are necessary in small quantities for the attainment of full growth.
>
> The degree to which the other described changes depend upon diet is another matter. Some of the changes in proportion, and especially the suggested adaptation of the pelvis and spinal column to the erect posture, appear likely to represent evolutionary changes which must be presumed to take place without regard to diet.

The mass of evidence on a wide diversity of material indicates that there is an environmental growth factor in man which influences the dimensions of the body roughly in proportion to the degree to which the various measurements are

correlated with stature but probably even more effective in the long bones. These changes are probably ascribable to changes in the diet. Of course there is a maximum potential growth for an individual genotype and the change will best be seen where the dietary contrast is great. Subsequently to the achievement of increased growth as a result of a more adequate diet, the altered physical form may in itself set up new evolutionary forces operating to select the most advantageous types under the altered conditions.

In the traits that were merely observed there also appear to be certain specific ways in which American-born Cantonese differ from immigrants. These consist in the greater hairiness of the American-born, the changed form of the nose, the increased prevalence of torus palatinus and in previously reported dental changes. Some confirmation for these findings can be adduced from comparisons with other material.

The increased hairiness of American-born Chinese which was noticed on the arms, fingers and eyebrows is paralleled by Shapiro's ('39) finding among Japanese that for both sexes and all areas of the body (including the head, arms, hands and eyebrows) the Hawaiian-born tended to be more hairy than the immigrants. However, if some specific factor in the changed environment is responsible for increasing hairiness, it does not seem to be as important in respect to the beard, where age may be a major influence. It may be appropriate to comment here that if the tendency to beardedness was introduced into the Chinese stock by an Armenoid type (as Shirokogoroff suggests) or by an Ainoid type (as might be inferred from the discovery of an Aino-like skull in the upper cave at Chou-kou-tien) the various distinguishing characters no longer remain associated in individuals.

In respect to torus palatinus the greater incidence in the American-born indicates that some environmental factor, possibly related to chewing habits and mechanics rather than nutrition, is important in the etiology of the trait.[9]

[9] I have examined twelve pairs of non-Chinese homozygous twins. Eleven pairs were concordant in respect to torus palatinus and this points to the importance of genetic factors in the etiology.

SUMMARY

In summarizing it may be said that measurements of Chinese males born and raised in the United States differ in certain specific respects from those of Chinese immigrants born in China. These differences consist in an increase in stature and in all measurements highly correlated with stature: notably all measurements of the trunk and limbs other than chest depth. Of the body indices, the thoracic, brachial, hand and foot indices tend to be lower in the American-born. Such changes are not limited to Chinese in continental United States. Similar tendencies have been noted for Chinese and Japanese born in and immigrant to Hawaii.

In the case of the head and face, differences between American-born and immigrant Cantonese are less significant. The American-born Chinese have wider and shorter heads, and have longer, narrower, higher noses and longer faces. The tendency towards a broader shorter head and lower nasal, nose salient, fronto-parietal, cephalo-facial, fronto-gonial and zygo-gonial indices is found also in Chinese and Japanese born in Hawaii. The tendency to an increase in facial lengths, though reported also for Chinese males born in Hawaii, seems not to hold for Japanese.

The typical Oriental youth born and brought up in the United States or Hawaii, when compared with immigrants from the region from which his ancestors have come, differs in ways which may be ascribed to an "environmental growth factor." He is taller with longer arms and legs, relatively slenderer hands and feet and flatter chest. His head is likely to be shorter but broader and his nose to be relatively narrower. He has more body hair. Such changes are exemplified in Chinese in America and seem to signify a process caused by changed dietary or other factors attendant upon the migration of peoples.

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THE BEARING OF ETHNIC AND GENETIC CONDITIONS ON THE BLOOD GROUPS OF THREE FUEGIAN TRIBES

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ONE TEXT FIGURE AND FIVE PLATES

INTRODUCTION

The question of blood groups in Fuegian tribes offers special interest. Various authorities, using craneological data, have attributed Australoid characters to these tribes, by which they would differ from the majority of the American Indians (Rivet, '43). In our own recent experience with living Fuegians, however, their external characters — pigmentation of the skin, quality and distribution of hair, high cheekbones and slit eyes — are so similar to what is known for American Indians in general, that one cannot but notice what Rivet ('40) called the American "air de famille." But on the other hand, certain blood group findings in Yámanas (or Yahgans [2] seemed to favor the concept that the Fuegians differ biologically and by origin from the rest of the autochthonous American population. Whereas, as generally known, in the American Indian population group O prevails [3] — sometimes 100 or almost

[1] Under the auspices of the Universidad de Chile, Dirección General de Informaciones y Cultura, Departamento de Medicina Experimental del Servicio Nacional de Salubridad, and Museo Nacional de Historia Natural. Prof. A. Lipschutz, Departamento de Medicina Experimental, was Chief of the Mission; Dr. Mostny represented the Museo Nacional; Dr. Robin, the Musée de l'Homme, Paris.

[2] For explanation of these terms, see Bridges ('33, p. x), Gusinde ('37, pp. 192–198).

[3] Editor's Note: Dr. William Boyd points out that as a general statement this is true, but that it holds equally for Europeans and white Americans. In view of Matson's ('38) work, where over 50% group A was present in some North American tribes, it cannot be said that American Indians are nearly always group O, although this does apply to many South American tribes.

100% — Rahm ('31) found that out of thirty-three Yámanas examined by him, only three were group O and thirty group B. From these findings and from others which showed a high percentage of A in different groups of American Indians (Wiener, '43, p. 297), bold conclusions were drawn, notwithstanding the fact that prevalence of group O, as in American Indians in general, was found by Rahm himself in another Fuegian tribe, the Onas (or Shelknams or Selk'nams,[4] on whose australoid characters different authorities have insisted even more than in the case of the Yámanas (Rivet, '40). The above findings and conclusions seemed to justify a more precise study of blood groups in Fuegians, especially since the fullbloods are on the way to extinction. Miscegenation with Whites and a high mortality rate from tuberculosis are the causes.

ETHNIC AND GENETIC CONDITIONS

To understand our special methods of inquiry and the results thereof, it is necessary to hold in mind that a considerable number of the individuals in these tribes actually have some white ancestry from one of the parents or grandparents. Almost immediately at the beginning of our work with the Fuegians we became aware of the relevance of these special genetic or racial conditions. This is why a very careful inquiry was made about the parents, and, where possible, the grandparents of every individual to be serologically examined. In this inquiry we relied upon information supplied by the Indians themselves or their relatives, by the white farmers or administrators who have known these Indians for many years, by the civil and sanitary authorities, and in some cases by the members of the Salesian Mission.

The term "genetic" has generally vague connotations in human affairs, as also in our special study where we had to learn the genos (γένος) of the parents by relying mostly on their ethnos (ἔθνος), even though genos in primitive tribes, as in our own society, does not always coincide with ethnos.

[4] For explanation of these terms see Beauvoir ('15, ftn. p. 178), Gusinde ('31, pp. 121–124).

Because of this we were sometimes in a vicious circle when we tried to determine the genos of an individual by the ethnos of his parents. But there is practically no other effective way of establishing the genetic status of an aborigine when external signs of crossing with Whites are lacking. These details concerning the "genetic" status of our subjects are fundamental to the interpretation of our results.

The inquiry about ethnic and genetic conditions was made by Dr. Grete Mostny. These data were repeatedly checked, especially with the help of Sr. Octavio García of the Health Service of the Province of Magallanes. Sr. García has lived 8 years on the island of Navarino and personally knows all of the 250 inhabitants under his sanitary supervision. Social relations between the large farmers and the authorities on one side and the Indians and mestizos on the other, are very close and do not differ in any way from those one finds between the different social strata in a racially homogeneous population.

In table 1 a detailed picture is given of the genetic antecedents of all the seventy-seven individuals we studied. Indeed, one must not forget that the concept of ethnos — on which our data about genos are based — is arbitrary and subjective. The statement that an individual belongs to a certain ethnic group means no more than that he considers himself a member of a particular tribal, national or cultural group.

The arbitrary and subjective characters of the concept of ethnos in a primitive tribe, though in a state of transculturation, may best be exemplified by certain of our observations on what has been called "ethnic mutation" (Lipschutz, '44, pp. 37, 85, 148–151, 162).

An Indian of one tribe sometimes claims affiliation with another tribe. For example, we met a Yámana and his sister, or half sister, whose father was "Chilean" and mother Alakaluf (LXXI and LXXII in table 1; see also fig. 1 and plate 4). They were Yámana because they were brought up as orphans by a Yámana woman. Yámana was their mother tongue and

TABLE 1

Ethnic and genetic composition of sample with corresponding blood groups.

NUMERICAL DESIGNATION [1]	ETHNIC AFFILIATION OF INDIVIDUAL [2]	ETHNIC AFFILIATION OF PARENTS: Father	Mother	GENETIC IDENTIFICATION	BLOOD GROUP: O	A	B	AB	Total
I–V	O	*O*	*O*	O	*5*	..	..	..	*5*
VI	Y	Ar//O	O	O	1	..	..	..	1
VII–IX	1 O, 2 M	C	O	O	3	..	..	..	3
X	O	S	O	O	..	1	..	..	1
XI–XII	? (children of X)	E	S//O	O	..	..	1	1	2
XIII–XX	Ar	W	W//O	O	5	1	2		8
XXI–XXXI	Y	*Y*	*Y*	Y	*11*	..	..	..	*11*
XXXII–XXXIII	Y	*Y*	*A*	Y	*2*	..	..	..	*2*
XXXIV–XL	Y (children of XXX and XXXIII)	*Y//A*	Y	Y	*7*	..	..	..	*7*
XLI	Y (child of XXI and LXXII)	Y	C//A	Y	1	..	..	..	1
XLII	Y (child of LXXI and XXII)	C//A	Y	Y	1	..	..	..	1
XLIII	Y	Ar	Y	Y	..	1	..	..	1
XLIV–XLVIII	Y (children of XLIII)	Ar//Y	Y	Y	3	2	..	..	5
XLIX–L	Y (children of XLIV and XXVI)	Ar/Y//Y	Y	Y	1	1	..	..	2
LI	M–Y	E	Y	Y	1	..	..	..	1
LII	Y	C	Ar/Y//Y	Y	1	..	..	..	1
LIII	Y (child of VI and XLVIII)	Ar/O//O	Ar/Y//Y	Y	1				1
LIV	Y (child of XXXII)	C	Y//A	Y	1	..	..	..	1
LV–LIX	C	S	Y//O (A?)	Y	1	4	..	..	5
LX	C (child of LV)	C	S//Y/O (A?)	Y	..	1	..	..	1
LXI–LXIX	A	*A*	*A*	A	*9*	..	..	..	*9*
LXX	?	C//A	A	A	1	..	..	..	1
LXXI–LXXII	Y	C	A	A	2	..	..	..	2
LXXIII–LXXVII	? (children of LXIX)	Ch	A	A	1	..	4	..	5

[1] Instead of family name.

[2] Symbols: // — separates father from mother of respective parent; / — separates grandfather from grandmother; ? — ethnic

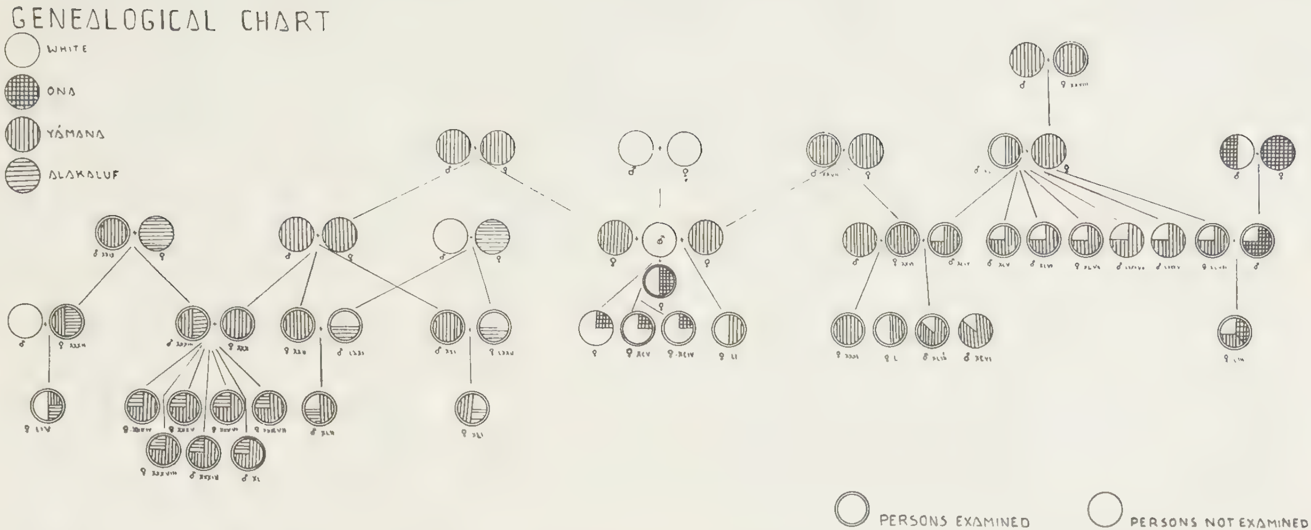

Fig. 1 Genealogical chart of the Yámana tribe. The chart comprises about two-thirds of the individuals who belong to the Yámana tribe, or though not actually considered or not considering themselves as Yámanas, have among their grandparents at least one individual who belonged to it. The chart also includes several individuals of Ona or Alakaluf extraction who consider themselves as Yámanas or live among them.

The double circles indicate persons who were examined as to their ethno-genetic antecedents. The single circles indicate persons who could not be examined (dead, or absent at the time when our studies were made).

As explained in the text, individuals of Ona or Alakaluf extraction who consider themselves as belonging to the Yámana ethnos, were nevertheless fully conscious of their different genos.

Number L is probably a child out of wedlock of XXVI.

they considered themselves Yámana and were so considered by the tribe. Like other members of the tribe, the man owned a share in the land allotted to the tribe in Mejillones on Navarino. Of interest also was case VI (plate 5), a man 47 years old, whose mother was Ona and whose father was an Argentine-Ona cross. Besides Spanish, he speaks Ona and Yámana. He insists on being a Yámana because he is married to a woman of Yámana extraction (XLVII), lives among Yámanas, and partakes of Yámana social interest. His young wife declares that their child (LIII) of 1 year is Yámana.

No less interesting are the cases of ''ethnic mutation'' where mestizos pass from Indian to Whites. It seems, for instance, quite natural that the mestizos LV to LIX, born of a Fuegian mother, are Chileans because their Chilean father is a sheep farmer, a man of relative wealth, and of pure Spanish stock who educates them as his legal children. But quite different is the case of LXX (plate 4), a cow-boy born of an Alakaluf mother and a Chilean-Alakaluf father; or case XLIII (plate 5), a laborer on a farm, born of a Yámana mother and an ''Argentine'' father. The latter (XLIII) is a Yámana and it would seem unnatural for him to be anything different. But the former (LXX), a not very intelligent youth of about 16, does not wish to be reckoned as an aborigine. ''No quiero que me retraten en los diarios'' (''I don't want to have my picture in the papers''), he shouted from horseback when politely asked for permission to photograph him. ''No quiero ser indigena'' (''I don't want to be an aborigine''), he said almost anxiously, though talking quite calmly about his Alakaluf genos. His anxiety was apparently due to a somewhat nebulous conception of the sociological truth that his ethnic mutation from Indian to White would be in flagrant contrast to his actual and prospective economic and social conditions.

Thus it should be fully evident that when we speak about the genetic conditions, or genos, we establish only the fact that the respective individual, or other persons more or less reliable or benevolent to this individual, have declared that his parents or grandparents considered themselves or were

considered by others as belonging to a certain ethnic group which the investigator on his part considers to be genetically homogeneous. It is a kind of an ultimate identification of a certain ethnos with a genos which supposedly corresponds to this ethnos and to no other.

BLOOD GROUPS

Keeping this genetic background in mind, we will now discuss the blood groups of the Onas, Yámanas and Alakalufs. The first two were studied by Rahm ('31), whereas the last has never before been studied serologically.

In the course of our expedition, the Onas were examined by Dr. Louis Robin, principally in the Salesian Mission in Rio Grande on the Atlantic Border of Isla Grande of Tierra del Fuego, and in the village of Rio Grande itself. Individual Onas were found also in some parts of the island of Navarino. The Yámanas were examined by Dr. Antonio Santiana [5] on various large farms on the northern border of the island of Navarino and on the southern border of Isla Grande. The Alakalufs were examined by Dr. Santiana and Dr. Robin in Punta Arenas where they had been brought for casual exhibition at an eucharistic congress. A family of Alakaluf extraction also was encountered at La Rinconada about 49 km from Punta Arenas, where the family lives on the shore of the Strait of Magellan.

The blood sera used were prepared by the Blood Transfusion Service of the "Hospital San Vicente" in Santiago (School of Medicine). The sera were repeatedly tested with individuals of known blood groups.

The findings in the three Fuegian tribes are summarized in table 2. Out of seventy-seven individuals, there were thirty-four whose parents, and in many cases grandparents as well, considered themselves or were considered by others as Ona, Yámana or Alakaluf, or crosses between these. All of these thirty-four individuals belonged to group O.

[5] A guest of the Mission, from the Universidad Central of Quito, Ecuador.

On the other hand, out of forty-three individuals born from crosses with Whites, only twenty-four belonged to group O. Table 3, in which blood group distributions are given separately for Indians and mestizos, illustrates this. All of the nineteen individuals shown in table 2 as having groups A, B

TABLE 2

Blood group sample relative to total population.[1]

TRIBE [2]	NUMBER EXAMINED	BLOOD GROUP				TOTAL POPULATION
		O	A	B	AB	
Ona	20	14	2	3	1	40 [3]
Yámana	40	31	9	0	0	60 [3]
Alakaluf	17	13	0	4	0	80–100 [4]
Total	77	58	11	7	1	180–200 [4]
Per cent		75.3	14.3	9.1	1.3	

[1] This table comprises 53 individuals examined as to blood groups by Dr. Santiana and 24 individuals examined by Drs. Robin and Lipschutz.

[2] Explained by table 1.

[3] Exact figure.

[4] Approximation.

TABLE 3

Comparison of blood groups in Indians and Mestizos.[1]

TRIBE	NUMBER EXAMINED	"INDIANS" Total					"MESTIZOS" Total				
			O	A	B	AB		O	A	B	AB
Ona	20	5	5	0	0	0	15	9	2	3	1
Yámana	40	20	20	0	0	0	20	11	9	0	0
Alakaluf	17	9	9	0	0	0	8	4	0	4	0
Total	77	34	34	0	0	0	43	24	11	7	1
Per cent			100	0	0	0		56	26	16	2

[1] This subdivision is explained in table 1 and text.

or AB are mestizos. This suggests that the appearance of individuals of non-O groups in the Fuegians is due to an infiltration of these blood factors through miscegenation with Whites.

In Rahm's sample of Onas there was 90% of group O, whereas in ours there was only 70%. One may reasonably

suppose that the smaller percentage we found in Onas was due to an increase of White admixture in the course of the last 15 years. More evidence as to this will be given in the next section.

The new blood group determinations for Yámana give the same high percentage of group O as in other American Indian populations greatly mixed with Whites, and are diametrically opposed to those of Rahm, who found in thirty-three Yámanas only three with group O and thirty with group B. In Alakalufs likewise we found the typical high percentage of O.

The results given in table 2 show clearly that the distribution of blood groups in the three Fuegian tribes is similar to that of the great majority of Indian and mestizo populations in the New World. We are fully aware of the disadvantage of dealing with only a small number of Fuegians, but if one compares the number examined with the total number of individuals in the respective tribe as given in the last column of table 2, one sees that we dealt with half of the Ona and almost two-thirds of the Yámana population.[6] As to Alakalufs, it is

[6] Editor's note: Dr. William C. Boyd believes that this statement presents us with a dilemma which the authors do not explain. The present study found no group B in the 40 Yámanas, taken from a total Yámana population of 60. Thus there were only 20 Yámanas unexamined by the writers. Yet Rahm about 1930 tested 33 Yámanas and found 30 with group B. Therefore it would seem that the present study did not test any of the 30 group-B individuals studied by Rahm and probably not many of their descendants (some of which would also be group B). If this is so, and if there are only 60 Yámanas left, what happened to these 30 group-B Yámanas and their descendants? Dr. Boyd asserts that there is no reason to doubt the serological techniques of this study or of Rahm's, but he cannot fully reconcile the two reports as they are stated. In discussing this matter by correspondence with Prof. Lipschutz, the latter has advanced the following ingenious explanation: ''According to my feeling, which is that of one who has worked for 40 years in experimental research, the statement of Rahm must have been due to some accidental mistake, probably made when copying the results.'' The following scheme shows how such a mistake could have been made:

	Total	O	A	B	AB
Rahm	33	3	0	30	0
Rahm (corrected	33	3←	$\boxed{0}$ ←	$\boxed{3}$0	0
tentatively by A.L.)	33	30	3	0	0
Our results	40	31	9	0	0
Our results without the 6 "Chileans" (LV to LX)	34	30	4	0	0

extremely difficult to meet them in considerable numbers because they wander in their canoes through the channels.

FAMILY RELATIONS OF INDIVIDUALS BELONGING TO NON-O GROUPS

A detailed study of the family relations of the individuals of A, B, and AB groups corroborated the infiltration of White blood.

The nine Yámanas having group A (table 1) were members of two different families. In the first one, the father (XLIII) was born of a Yámana mother and an "Argentine" father (see fig. 1; plate 5). Both he and two of the five children we examined (XLIV to XLVIII) were group A. The first married a Yámana woman and one of his descendants was again group A (fig. 1, indiv. L). In the second family the father was a Spaniard with group A who had five children by a woman whose father was Yámana and mother Ona or Alakaluf. She was no longer alive when the family was examined. Four out of the five children were group A (LV to LIX). The oldest daughter who was group A married a Chilean of group O and their first child was group A (LX).

Four group B individuals (LXXIV to LXXVII) out of seventeen Alakalufs (table 1) were children of an Alakaluf woman and a "Chilote" father (mestizo stock of the island of Chiloé). The father was group B.

In our Ona material there was a woman born of an Ona mother and a Spanish father. She was group A (fig. 1, indiv. X), and married to an Englishman whose group we were not able to determine. Two of her three children we examined were group B or AB (XI and XII).

Whatever may be said about the Australoid somatic characters or an Australian origin of one or another of these Fuegian tribes, the fact remains that all Onas, Yámanas and Alakalufs, or crosses thereof, belonged to group O, which is possibly a serological characteristic of them.

SUMMARY

A careful inquiry was made into the ethnic condition or "genetic" antecedents of each of seventy-seven individuals belonging to the Fuegian tribes —Onas, Yámanas and Alakalufs — or related to these by one parent or grandparent. These seventy-seven individuals represent about 40% of the total indigenous Fuegian population.

Out of the total of seventy-seven individuals only thirty-four were separated as seemingly free from white antecedents.

The blood group distribution of these seventy-seven individuals is much the same as in most American populations composed of Indians and Indian-White crossses. Thus fifty-eight individuals, or 75%, were group O and the remaining nineteen individuals were non-O. The same is true for each tribe considered separately.

All the thirty-four individuals sorted as free from white antecedents belonged to group O whereas all the nineteen individuals who belonged to non-O groups were shown to have white antecedents among parents, grandparents, or great-grandparents.

In short, all the thirty-four Fuegian Indians of the Ona, Yámana and Alakaluf tribes belonged to group O, and in the nineteen individuals showing groups A, B and AB, miscegenation with Whites of Chilean, Argentine, Spanish or English extraction could be traced.

Cordial thanks are due to our Geographical advisor, General Ramón Cañas Montalva; to Com. Lt.-Col. Gustavo Luco; to the Armed Forces and especially the Air Force of Chile, under General Tovarias and Com. Donoso in Magallanes, for unique facilities afforded; to the Naval Authorities of Ushuaia, Argentina, under Admiral Portillos; to the farmers of the island of Navarino and Isla Grande de Tierra del Fuego who lodged and fed us; and last but not least to our Indian friends and brothers.

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PLATE 1

EXPLANATION OF FIGURES

Above. Ona (I). Living in Río Grande, Isla Grande de Tierra del Fuego, Argentina. 42 years old. Both parents were Ona.

Below left. Ona (V). Misión Salesiana, Río Grande. 31 years old. Both parents were Ona.

Below right. Ona (IV). Misión Salesiana, Río Grande. 3 years old. Both parents were Ona.

PLATE 1

PLATE 2

EXPLANATION OF FIGURES

Above left. Yámana (XXI). Yendegaia, southern shore of Isla Grande. 31 years old. Both parents were Yámana.

Above right. Yámana (XXIV). Puerto Navarino, Island of Navarino. 45 years old. Both parents were Yámana.

Below. Yámana (XXX). Santa Rosa, Island of Navarino. 32 years old. Both parents were Yámana. The father (XXXIII) of the child (XL) came from a Yámana father (XXIX) and an Alakaluf mother.

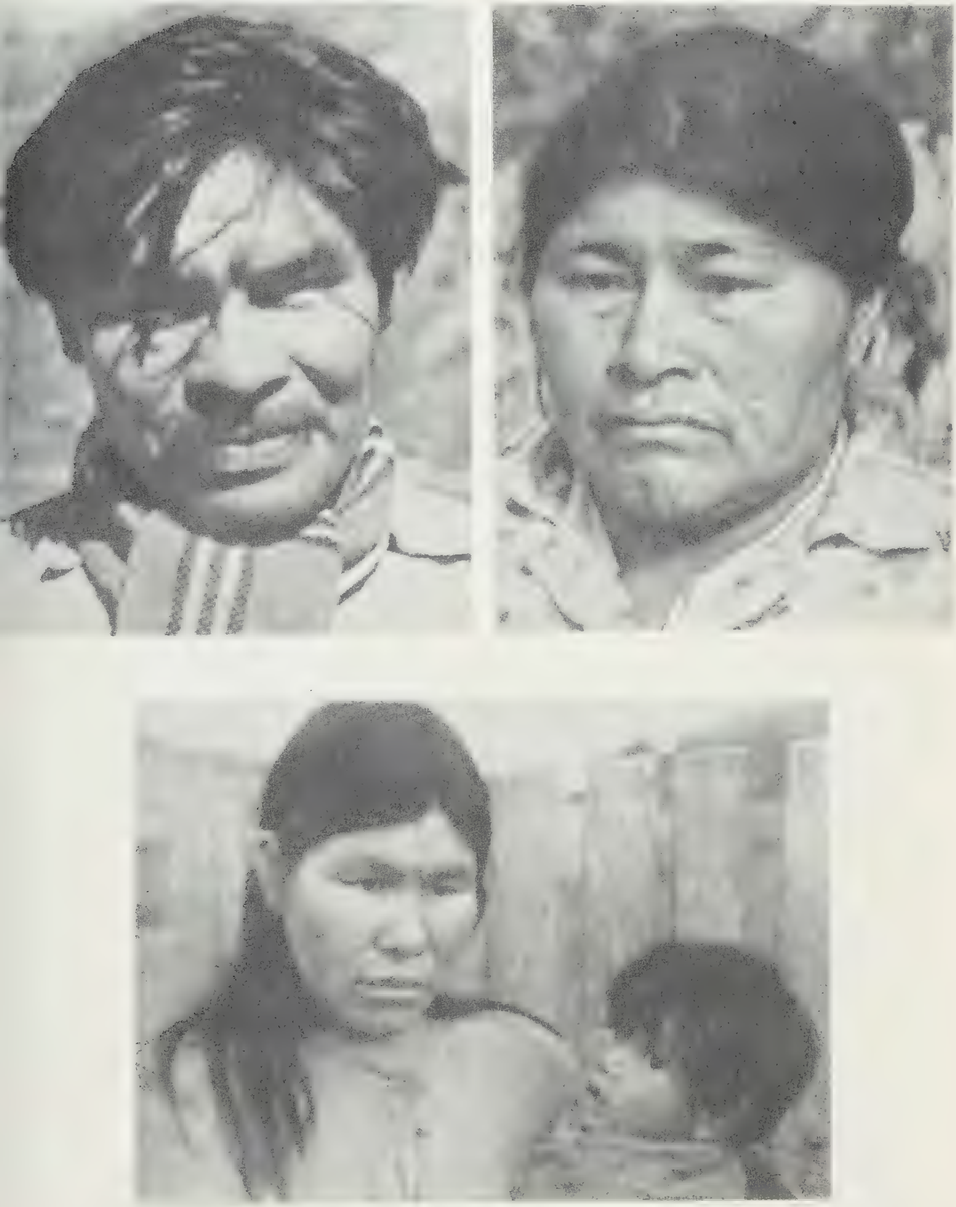


PLATE 3

EXPLANATION OF FIGURES

Above. Alakaluf (LXI). Living in Puerto Eden, Island of Wellington, but met in Punta Arenas. 32 years old. Both parents were Alakaluf.

Below. Alakaluf (LXVI). Living in Puerto Eden, Island of Wellington, but met in Punta Arenas. Age unknown. Both parents were Alakaluf.

PLATE 4

EXPLANATION OF FIGURES

Above left. "Yámana" (LXXI). Yendegaia. 28 years old. Father Chilean, mother Alakaluf (for explanation see text). For blood groups this "Yámana" was sorted as Alakaluf in table 2 and as Alakaluf-Mestizo in table 3.

Above right. "Yámana" (LXXII). Yendegaia. Sister of LXXI. Age was given as 28 also. Classed as above.

Below. "I don't want to be an aborigine" (LXX). Yendegaia. 16 years old. Father Chilean-Alakaluf, mother Alakaluf. For blood groups, classed as Alakaluf in table 2 and as Alakaluf-Mestizo in table 3.

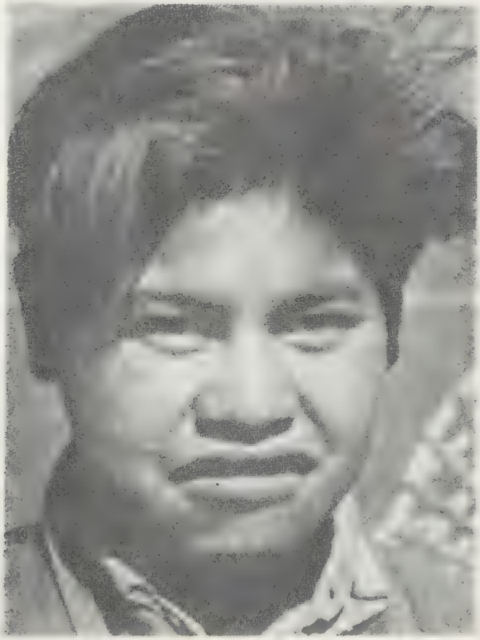


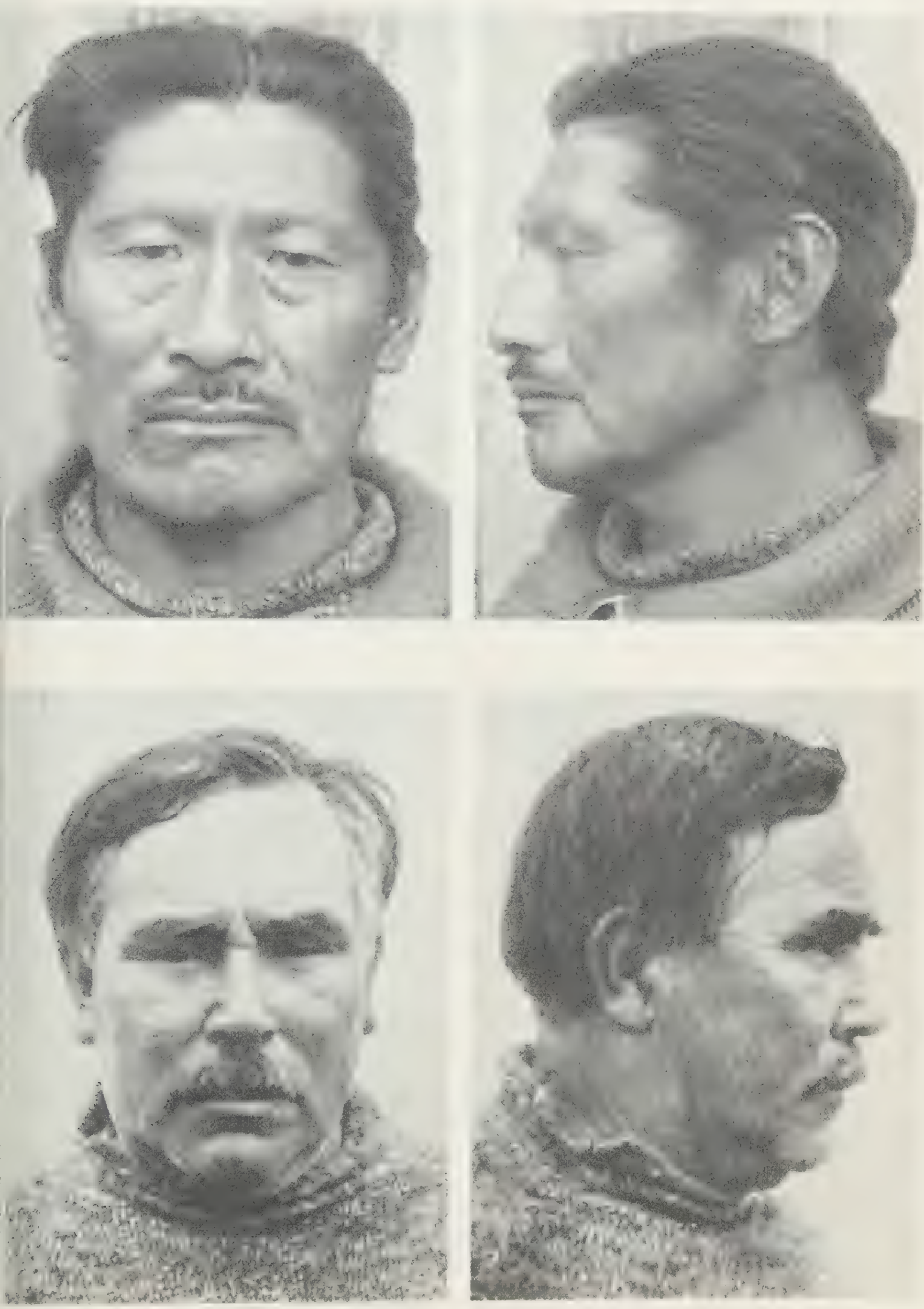
PLATE 5

EXPLANATION OF FIGURES

Above. "Yámana" (VI). Puerto Róbalo, Island of Navarino. 47 years old. Father Argentine-Ona, mother Ona (for explanation see text). For blood groups classed as Ona in table 2 and as Ona-Mestizo in table 3.

Below. "Yámana" (XLIII). Puerto Harberton, southern shore of Isla Grande. 51 years old. Father Argentine, mother Yámana (for explanation see text). For blood groups classed as Yámana in table 2 and as Yámana-Mestizo in table 3.

PLATE 5



Sex Difference in Coronary Disease.— The intima of the coronary arteries, already known to be thicker than that of any artery of similar caliber elsewhere in the body, is much thicker in males than in females, and this anatomic peculiarity is easily demonstrable in newborn infants. This is believed to establish the basis for the sex difference in the incidence of coronary occlusion and to prove that the predilection of atherosclerosis for the coronary arteries is due to their possessing an intima varying in thickness from 10 to 600 per cent of that of the media, and averaging 26 per cent in newborn males, 8 per cent in females.— William Dock, The predilection of atherosclerosis for the coronary arteries. J. Am. Med. Assn., vol. 131, no. 11, 1946, pp. 875–878.

Man of Chancelade and the Eskimo.— It is now known that Neanderthal Man, who formerly was believed to be localized in Europe, diffused during the Middle Paleolithic throughout the Old World. The discovery at Choukoutien warrants the supposition that the same thing applies to Upper Paleolithic Man, and that the races, first discovered in France, then extended to all Western Europe, were living also in a great part of Asia. The resemblances between the Man of Chancelade and the Eskimo is explained then without resort to a migration in pursuit of reindeer. Although this explanation has given rise to a large literature, nothing in prehistory as yet has confirmed its existence.— H. V. Vallois (freely translated). Nouvelles recherches sur le squelette de Chancelade. L'Anthrop., tome 50, no. 1–2, 1946, pp. 65–202.

War and Dental Caries.— World War II appears to have reduced the incidence of dental caries in Norway to an appreciable extent. This is one of many points made at a recent meeting of the Norwegian Dental Association attended by the government's chief medical officer, Dr. Evang, Professor Toverud and others. It was pointed out that there was a remarkable uniformity in the reports from widely separated parts of the country on the diminution of dental caries. This diminution, in the opinion of Professor Toverud, may possibly have depended on a wartime dietary in which coarsely ground flour, increased consumption of vegetables, shortage of sweets and special provision for milk to expectant mothers and children may have played a part.— Special Correspondent from Oslo, Dental welfare in Norway. J. Am. Med. Assn., vol. 131, no. 11, 1946, p. 936.

ANTHROPOMETRY OF TRANSJORDAN BEDOUIN WITH A DISCUSSION OF THEIR RACIAL AFFINITIES [1]

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FOUR PLATES

The Howeitat and Beni Sakhr Bedouin were selected for further study from a group of 791 Transjordan tribesmen and villagers whose head-forms had been investigated by the writer ('34). They were reputed to be among the purest of the Transjordan Bedouin and it was thought that they would be a suitable type, because of their similarity in head-form to the Rwala tribe, for comparison with the Syrian Bedouin. Earlier studies by the writer (Shanklin, '35, '36) on three Syrian Bedouin tribes showed the Rwala to be strikingly different in their anthropometry from the neighboring Maualy and Akeydat tribes who were very similar to each other.

Significance ratios, which are defined on page 337, have been determined between the Beni Sakhr, the Howeitat and the following groups: the Rwala Bedouin described by Shanklin ('35), the Akeydat and Maualy Bedouin studied by the writer ('36), the four groups of Syrian desert border dwellers described by Shanklin ('38), the Riffians described by Coon ('31) and the Iraq males published by Field ('35). Comparative material for other Near East racial groups, skeletal and living, was included in the paper by Seligman ('17) and in the above papers, especially that by Coon, and will not be repeated in this report.

[1] This investigation was made possible by a grant in aid from the National Research Council. The manuscript was completed in 1941.

Serology

Serological studies on the Rwala, Akeydat and Maualy Bedouin led the writer (Shanklin, '35b, '36b) to believe there were fundamental differences between the percentages of blood group O, between the Bedouin, the desert border villagers and the Lebanese studied by Parr (Kappers and Parr, '34). Although the writer published high percentages of blood group O for three Bedouin tribes (Akeydat 74.8, Rwala 83.2 and Maualy 89.2), Boyd and Boyd ('38) did not secure unusually high percentages of blood group O for Syrian Bedouin. They found the following distributions for 208 Rwala: O 43.3, A 22.1, B 30.3, AB 4.3; and for 80 Akeydat: O 35.0, A 25.0, B 27.5, AB 12.5. Blood samples were secured in the Transjordan on eighty Beni Sakhr and eighty-six Howeitat males. The percentages of blood groups for these two were: Beni Sakhr, O 58.7, A 12.5, B 20.0, AB 8.8, Howeitat, O 52.3, A 11.6, B 32.6, AB 3.5. The writer hopes to secure blood samples at some future date from the Akeydat and the Rwala in order to determine the reason for the wide discrepancy between the results obtained by the Boyds and those by Shanklin.

Observations

The observed characteristics are included in table 1 and the range, mean, standard deviations and coefficients of variation for age, fifteen measurements [2] and fifteen indices are included in tables 2 and 3.

Skin color. Light and medium brown skins were most frequently encountered in the desert. The distribution of these colors from observations on the forehead are: Beni Sakhr 76.8 and Howeitat 68.1, and from the inner arm 59.6 and 64.7%, respectively. Red-brown skins are often seen, Beni

[2] The definitions of measurements and indices employed have been published (Shanklin, '38, p. 405) and will not be repeated here. The Harvard University Anthropometry forms were used in this study and many observations are recorded that were not included in the writer's previous studies.

TABLE 1

Observations on Transjordan Bedouin.

	HOWEITAT		BENI SAKHR			HOWEITAT		BENI SAKHR	
	No.	%	No.	%		No.	%	No.	%
n color, forehead					*Skin color, inner arm*				
3runet	0		1	1.79	Brunet	0		4	7.02
'warthy	0		1	1.79	Swarthy	1	1.47	4	7.02
ted-brown	11	15.94	6	10.71	Red-brown	22	32.35	9	15.79
ight brown	20	28.99	12	21.43	Light brown	28	41.18	22	38.60
ight yellow-brown	0		1	1.79	Light yellow-brown	0		0	
'ellow-brown	11	15.94	1	1.79	Yellow-brown	0		1	1.75
fedium brown	27	39.13	31	55.36	Medium brown	16	23.53	12	21.05
hocolate	0		3	5.36	Chocolate	1	1.47	4	7.02
	69		56		Dark brown	0		1	1.75
						68		57	
r form					*Hair texture*				
traight	25	36.23	8	13.33					
ow waves	15	21.74	21	35.00					
eep waves	12	17.39	13	21.67	Coarse	42	60.87	22	37.29
urly	15	21.74	18	30.00	Medium	7	10.14	14	23.73
rizzly	0		0		Fine	20	28.99	23	39.00
Voolly	2	2.90	0			69		59	
	69		60						
r quantity, head					*Baldness*				
ubmedium	20	28.99	11	18.64	Absent	41	62.12	43	74.14
ledium	29	42.03	30	50.85	Submedium	8	12.12	12	20.69
ronounced	20	28.99	18	30.51	Medium	16	24.24	3	5.17
	69		59		Pronounced	1	1.52	0	
						66		58	
r quantity, beard					*Hair quantity, body*				
ery small	9	13.43	8	13.56	Absent	4	14.81	0	
ubmedium	30	44.78	23	38.98	Submedium	18	66.67	6	33.33
ledium	20	29.85	16	27.12	Medium	4	14.81	11	61.11
ronounced	7	10.45	11	18.64	Pronounced	1	3.70	1	5.56
ery pronounced	1	1.49	1	1.69		27		18	
	67		59						
yness, head					*Grayness, beard*				
bsent	54	79.41	46	76.67	Absent	50	73.53	41	68.33
ubmedium	9	13.24	2	3.33	Submedium	10	14.71	7	11.67
ledium	3	4.41	6	10.00	Medium	2	2.94	4	6.67
ronounced	2	2.94	6	10.00	Pronounced	6	8.82	8	13.33
	68		60			68		60	

TABLE 1 — *(continued)*

Observations on Transjordan Bedouin.

	HOWEITAT		BENI SAKHR	
	No.	%	No.	%
Hair color, head				
Black	14	21.21	18	33.33
Dark brown	38	57.57	26	48.15
Brown	5	7.57	8	14.81
Light brown	0		0	
Reddish brown	8	12.12	0	
Red	1	1.51	2	3.70
	66		54	
Eye color				
Black	1	1.45	0	
Dark brown	64	92.75	22	36.67
Dark-light brown	2	2.90	7	11.67
Light brown	2	2.90	30	50.00
Gray-brown	0		1	1.67
	69		60	
Eyefolds, external				
Absent	53	76.81	44	77.19
Submedium	2	2.90	4	7.02
Medium	6	8.70	4	7.02
Pronounced	8	11.59	5	8.77
	69		57	
Eyefolds, internal				
Absent	69	100.00	55	98.21
Submedium	0		1	1.79
Medium	0		0	
	69		56	
Eye opening height				
Submedium	22	32.35	13	22.81
Medium	45	66.18	42	73.68
Pronounced	1	1.47	2	3.51
	68		57	
Eyebrow concurrency				
Absent	50	72.46	27	46.55
Submedium	12	17.39	24	41.38
Medium	6	8.70	7	12.07
Pronounced	1	1.45	0	
	69		58	

	HOWEITAT		BENI SA[illegible]	
	No.	%	No.	[illegible]
Hair color, beard and mustache				
Black	20	40.82	19	[illegible]
Dark-brown	28	57.14	24	[illegible]
Brown	1	2.04	3	[illegible]
Light brown	0		0	
Reddish brown	0		0	
Red	0		0	
	49		46	
Iris				
Clear	58	84.06	26	[illegible]
Rayed	11	15.94	31	[illegible]
Scalloped	0		2	[illegible]
	69		59	
Eyefolds, median				
Absent	29	42.03	47	[illegible]
Submedium	20	28.99	7	[illegible]
Medium	16	23.19	3	[illegible]
Pronounced	4	5.80	0	
	69		57	
Eye obliquity				
Absent	54	78.26	46	[illegible]
Submedium	3	4.35	4	[illegible]
Medium	4	5.80	1	[illegible]
Pronounced	1	1.45	2	[illegible]
Down	7	10.14	5	[illegible]
	69		58	
Eyebrow thickness				
Submedium	14	20.59	7	[illegible]
Medium	49	72.06	38	[illegible]
Pronounced	5	7.35	12	[illegible]
	68		57	
Browridges				
Absent	21	33.87	17	[illegible]
Submedium	17	27.42	24	[illegible]
Medium	20	32.26	11	[illegible]
Pronounced	4	6.45	2	[illegible]
Very pronounced	0		1	[illegible]
	62		55	

TABLE 1 — *(continued)*

Observations on Transjordan Bedouin.

	HOWEITAT		BENI SAKHR	
	No.	%	No.	%
ehead height				
ubmedium	4	5.80	11	19.30
edium	54	78.26	37	64.91
ronounced	11	15.94	9	15.79
	69		57	
ion depression				
bsent	5	7.25	5	8.77
ery small	17	24.64	9	15.79
ıbmedium	26	37.68	19	33.33
edium	18	26.09	17	29.82
ronounced	3	4.35	7	12.28
	69		57	
al root breadth				
ery small	1	1.45	5	8.77
ıbmedium	13	18.84	14	24.56
edium	32	46.38	23	40.35
ronounced	19	27.54	15	26.32
ery pronounced	4	5.80	0	
	69		57	
l bridge breadth				
ıbmedium	2	2.90	0	
edium	28	40.58	18	32.14
onounced	37	53.62	36	64.29
ery pronounced, very small	2	2.90	2	3.57
	69		56	
l tip thickness				
bmedium	2	2.90	5	8.47
edium	28	40.58	20	33.90
onounced	35	50.72	25	42.37
ry pronounced, very small	4	5.80	9	15.25
	69		59	
l wings				
mpressed	10	14.93	17	28.81
edium	53	79.10	40	67.80
aring	4	5.97	2	3.39
	67		59	

	HOWEITAT		BENI SAKHR	
	No.	%	No.	%
Forehead slope				
Forward	1	1.45	0	
Absent	4	5.80	12	21.05
Submedium	28	40.58	33	57.89
Medium	33	47.83	10	17.54
Pronounced	3	4.35	2	3.51
	69		57	
Nasal root height				
Very small	0		2	3.39
Submedium	3	4.35	20	33.90
Medium	21	30.43	21	35.59
Pronounced	34	49.28	14	23.73
Very pronounced	11	15.94	2	3.39
	69		59	
Nasal bridge height				
Submedium	2	2.90	2	3.45
Medium	30	43.48	28	48.28
Pronounced	37	53.62	25	43.10
Very pronounced, very small	0		3	5.17
	69		58	
Nasal profile				
Concave	6	8.70	4	7.02
Straight	43	62.32	35	61.40
Convex	18	26.09	17	29.82
Concave, convex	2	2.90	1	1.75
	69		57	
Nasal tip inclination				
Up, submedium	4	5.80	7	11.86
Horizontal	11	15.94	22	37.29
Down, submedium	43	62.32	26	44.07
Down, medium	11	15.94	4	6.78
	69		59	
Lips integumental thickness				
Submedium	25	36.76	11	19.64
Medium	35	51.47	27	48.21
Pronounced	8	11.76	18	32.14
	68		56	

TABLE 1 — *(continued)*

Observations on Transjordan Bedouin.

	HOWEITAT		BENI SAKHR	
	No.	%	No.	%
Lips, eversion				
Submedium	7	10.14	9	15.79
Medium	37	53.62	32	56.14
Pronounced	22	31.88	15	26.32
Very pronounced	3	4.35	1	1.75
	69		57	
Mid-facial prognathism				
Absent	19	27.54	16	28.07
Submedium	23	33.33	21	36.84
Medium	25	36.23	18	31.58
Pronounced	2	2.90	2	5.51
	69		57	
Chin prominence				
Submedium	3	4.48	4	7.14
Medium	27	40.30	26	46.43
Pronounced	37	55.22	26	46.43
	67		56	
Malars frontal projection				
Absent, submedium	27	39.13	25	43.86
Medium	31	44.93	27	47.57
Pronounced	11	15.94	5	8.77
	69		57	
Gonial angles				
Submedium	1	1.45	8	14.29
Medium	17	24.64	18	32.14
Pronounced	44	63.77	30	53.57
Very pronounced	7	10.14	0	
	69		56	

	HOWEITAT		BENI SA	
	No.	%	No.	
Lip seam				
Absent	15	22.06	8	[illegible]
Submedium	13	19.12	19	[illegible]
Medium	23	33.82	17	[illegible]
Pronounced	17	25.00	11	[illegible]
	68		55	
Alveolar prognathism				
Absent	4	5.97	4	
Submedium	11	16.42	17	[illegible]
Medium	14	20.90	11	[illegible]
Pronounced	35	52.24	22	[illegible]
Very pronounced	3	4.48	1	
	67		55	
Chin type				
Median	51	76.12	40	[illegible]
Bilateral	16	23.88	16	[illegible]
	67		56	
Malars lateral projection				
Absent	1	1.45	1	
Submedium	5	7.25	3	
Medium	18	26.09	28	[illegible]
Pronounced	44	63.77	23	[illegible]
Very pronounced	1	1.45	2	
	69		57	
Ear helix				
Very small	5	7.25	15	[illegible]
Submedium	24	34.78	24	[illegible]
Medium	36	52.17	18	[illegible]
Pronounced	4	5.80	0	
	69		57	

TABLE 1 — (*continued*)

Observations on Transjordan Bedouin.

	HOWEITAT		BENI SAKHR	
	No.	%	No.	%
r antihelix				
Absent	1	1.45	3	5.36
Submedium	24	34.78	30	53.57
Medium	40	57.97	16	28.57
Pronounced	4	5.80	7	12.50
	69		56	
r lobe				
Soldered	7	10.14	4	6.67
Attached	12	17.39	31	51.67
Free	50	72.46	25	41.67
	69		60	
r protrusion				
Submedium	26	37.68	21	37.50
Medium	38	55.07	34	60.71
Pronounced	5	7.25	1	1.79
	69		56	
cipital protrusion				
Absent	0		0	
Submedium	13	18.84	17	29.82
Medium	50	72.46	38	66.67
Pronounced	6	8.70	2	3.51
	69		57	
nbdoid flattening				
Absent	51	73.91	38	66.67
Submedium	12	17.39	5	8.77
Medium	3	4.35	7	12.28
Pronounced	3	4.35	7	12.28
	69		57	
cial asymmetry				
Absent	68	100.00	54	98.18
Left	0		1	1.82
Right	0		0	
	68		55	

	HOWEITAT		BENI SAKHR	
	No.	%	No.	%
Darwin's point				
Absent	49	71.01	53	92 98
Submedium	7	10.14	4	7.02
Medium	10	14.49	0	
Pronounced	3	4.35	0	
	69		57	
Ear lobe size				
Absent	6	8.70	2	3.51
Submedium	46	66.67	41	71.93
Medium	14	20.29	12	21.05
Pronounced	3	4.35	2	3.51
	69		57	
Temporal fullness				
Submedium	7	10.14	14	24.56
Medium	58	84.06	41	71.93
Pronounced	4	5.80	2	3.51
	69		57	
Occipital flattening				
Absent	67	97.10	55	96.49
Medium	2	2.90	2	3.51
Pronounced	0		0	
	69		57	
Cranial asymmetry				
Absent	69	100.00	57	100.00
Body build				
Linear	69	100.00	46	82.14
Medium	0		10	17.86
Lateral	0		0	
	69		56	

Sakhr forehead 10.7 and Howeitat 15.9%, also yellow-brown skins were noted especially among the Howeitat, 15.9%.

Among the Syrian desert border dwellers and the Lebanese, brown skins are not frequently seen except among the Hidjaneh villagers where they are 18.1%. Along the desert border the skins are of brunet or medium color. These colors

TABLE 2

Howeitat: Number, range, means, standard deviations and coefficients of variation for Howeitat Bedouin (with probable errors).

	NO.	RANGE	MEAN	S.D.	V.
Age	69	20– 79	37.00 ± 1.19	14.70 ± .84	39.73 ± 2.28
Stature	70	152–181	163.08 ± .41	5.13 ± .29	3.15 ± .18
Span	70	158–190	173.49 ± .49	6.06 ± .35	3.49 ± .20
Sitting height	70	75– 92	85.00 ± .26	3.27 ± .19	3.87 ± .22
Head length	70	179–211	192.42 ± .49	6.09 ± .35	3.16 ± .18
Head breadth	70	129–158	145.12 ± .38	4.74 ± .27	3.27 ± .19
Head height	68	118–133	123.46 ± .38	4.64 ± .27	3.76 ± .22
Minimum frontal diameter	69	93–128	106.22 ± .41	5.08 ± .29	4.78 ± .27
Bizygomatic diameter	68	115–144	131.25 ± .43	5.25 ± .30	4.00 ± .23
Bigonial diameter	70	90–121	105.26 ± .42	5.20 ± .30	4.94 ± .28
Total face height	69	95–134	115.10 ± .51	6.25 ± .36	5.43 ± .32
Upper face height	70	55– 79	67.00 ± .37	4.55 ± .26	6.79 ± .39
Nose height	70	44– 63	51.66 ± .31	3.84 ± .22	7.43 ± .42
Nose breadth	70	28– 42	33.92 ± .20	2.52 ± .14	7.43 ± .42
Ear height	68	47– 73	60.39 ± .40	4.83 ± .28	8.00 ± .46
Ear breadth	68	28– 42	32.63 ± .22	2.64 ± .15	8.09 ± .47
Relative span	70	100–115	106.62 ± .22	2.68 ± .15	2.51 ± .14
Relative sitting height	70	48– 57	51.68 ± .12	1.48 ± .08	2.86 ± .16
Cephalic index	70	68– 85	75.51 ± .25	3.12 ± .18	4.13 ± .24
Length height index	68	58– 72	64.07 ± .26	3.18 ± .18	4.96 ± .29
Breadth height index	68	76– 96	84.98 ± .31	3.78 ± .22	4.45 ± .26
Fronto-parietal index	69	63– 89	73.09 ± .31	3.84 ± .22	5.25 ± .30
Cephalo-facial index	68	79– 99	90.11 ± .29	3.60 ± .21	4.00 ± .23
Zygo-frontal index	68	68– 87	80.66 ± .26	3.12 ± .18	3.87 ± .22
Fronto-gonial index	69	85–114	99.70 ± .41	5.10 ± .29	5.12 ± .29
Zygo-gonial index	68	69– 95	80.20 ± .33	4.08 ± .24	5.09 ± .29
Facial index	68	75–104	87.95 ± .44	5.35 ± .31	6.08 ± .35
Upper facial index	68	40– 63	50.57 ± .33	4.08 ± .24	8.07 ± .47
Nasal index	70	48– 87	66.34 ± .54	6.64 ± .38	10.01 ± .57
Ear index	68	41– 70	54.36 ± .46	5.61 ± .32	10.32 ± .60
Cephalic module	68	144–163	153.70 ± .29	3.52 ± .20	2.29 ± .13

range from 48.2 in Hafar to 75.3% in Hama. Light skins occur most frequently among the Hafar group, 37.4%.

The Riffian skin colors, unexposed parts, vary widely for light colored skins, range from the low percentage of 9.7 for Arabs and for Shluh, to 65.5 for Total Rif; likewise medium colored skins have the wide range of from 26.9% for

TABLE 3

Beni Sakhr: Number, range, means, standard deviations and coefficients of variation for Beni Sakhr Bedouin (with probable errors).

	NO.	RANGE	MEAN	S.D.	V.
Age	65	15– 79	42.55 ± 1.48	17.70 ± 1.05	41.60 ± 2.46
Stature	65	149–181	162.78 ± .55	6.63 ± .39	4.07 ± .24
Span	65	155–190	169.95 ± .63	7.53 ± .45	4.43 ± .26
Sitting height	64	75– 92	83.44 ± .34	4.02 ± .24	4.82 ± .29
Head length	65	176–202	189.87 ± .54	6.51 ± .39	3.43 ± .20
Head breadth	65	129–155	142.51 ± .37	4.44 ± .26	3.12 ± .18
Head height	62	110–133	123.70 ± .39	4.56 ± .28	3.69 ± .22
Minimum frontal diameter	64	93–116	104.06 ± .37	4.44 ± .26	4.27 ± .25
Bizygomatic diameter	65	120–144	130.60 ± .40	4.75 ± .28	3.65 ± .22
Bigonial diameter	65	90–117	102.90 ± .47	5.56 ± .33	5.40 ± .32
Total face height	65	105–139	120.15 ± .59	7.00 ± .41	5.83 ± .34
Upper face height	65	50– 84	68.90 ± .46	5.50 ± .33	7.98 ± .47
Nose height	65	40– 63	52.94 ± .35	4.16 ± .25	7.86 ± .46
Nose breadth	65	25– 42	33.38 ± .28	3.30 ± .20	9.89 ± .58
Ear height	64	53– 76	60.93 ± .36	4.29 ± .26	7.04 ± .42
Ear breadth	65	22– 42	32.45 ± .31	3.69 ± .22	11.37 ± .67
Relative span	65	100–113	104.32 ± .20	2.34 ± .14	2.24 ± .13
Relative sitting height	64	48– 55	51.18 ± .12	1.42 ± .08	2.77 ± .17
Cephalic index	65	68– 82	74.94 ± .25	3.00 ± .18	4.00 ± .24
Length height index	62	58– 72	65.24 ± .22	2.55 ± .15	3.91 ± .24
Breadth height index	62	76– 96	86.54 ± .19	2 22 ± .13	2.57 ± .16
Fronto-parietal index	64	63– 80	72.91 ± .21	2.49 ± .15	3.42 ± .20
Cephalo-facial index	65	82–102	92.09 ± .29	3.42 ± .20	3.71 ± .22
Zygo-frontal index	64	72– 87	79.58 ± .25	3.00 ± .18	3.77 ± .22
Fronto-gonial index	64	90–114	99.20 ± .45	5.15 ± .31	5.19 ± .31
Zygo-gonial index	65	69– 89	78.49 ± .29	3.48 ± .21	4.43 ± .26
Facial index	65	80–104	91.60 ± .44	5.20 ± .31	5 68 ± .34
Upper facial index	65	43– 63	52.85 ± .33	3.90 ± .23	7.38 ± .44
Nasal index	65	48– 99	63.90 ± .74	8.80 ± .52	13.77 ± .81
Ear index	64	35– 70	53.82 ± .54	6.42 ± .38	11.93 ± .71
Cephalic module	62	144–161	152.02 ± .35	4.10 ± .25	2.70 ± .16

Senhaja to 78.6 for Sheshawen. Among the Riffians dark colored skins were noted least for Total Rif 4.3 and most for Shluh 49.7%. Field ('35) did not publish observations of skin color for the Iraq series.

Among the Beni Sakhr and the Howeitat freckling of the skin was nearly always absent or submedium, the same was true for vascularity of the skin and for moles. Freckles were noted among the Riffians. Those designated as from one to three plus range from 7.5 for Arabs to 14.3% for Sheshawen.

Hair color. The color of the Beni Sakhr and Howeitat head hair is usually black or dark brown, 81.5 and 78.8%, respectively. Reddish-brown hair was noted among 12.1% of the Howeitat; red heads were seen once among the Howeitat and twice among the Beni Sakhr. The actual Beni Sakhr head hair color distribution on the Fischer-Saller hair color standards were: O 1; Q 1, S 2, T 4, V 11, W 15, X 10, Y 8, I 1, II 1, reddish-brown O; and the Howeitat distribution was: S 1, T 4, U 10, V 9, W 19, X 7, Y 7, II 1, reddish-brown 8.[3]

Among the Syrian Bedouin black or dark brown hair is dominant and ranges from 87.9 for Rwala to 100% for Maualy. For the desert border and mountain groups black or dark brown hair is also the dominant color. It is least frequent for the Hafar males, 81.8, and the others range within the narrow limits of 93.6 for Mhardeh and Alouite to 96.6% for Mitwali. Light brown hair was least frequent among the Alouite males, 2.8, most frequent among the Hafar males, 15.9%. Reddish-brown hair so common among the Howeitat (12.1) did not exceed 2% among the desert border or mountain groups. No red heads[4] were observed among these Syrian groups, but blond heads occurred twice among the Alouites and once in Hidjaneh.

The Riffian hair color distribution is very similar to the above, for in all groups black or dark brown heads are above

[3] The reddish-brown heads recorded here have no equivalent on the Fischer-Saller scale.

[4] Although no red heads were observed among the Syrians included in this study, red heads are occasionally seen in the Near East among the Armenians, the Jews and the Syrians.

90%. As with the Syrian groups the remaining hair colors are reddish-brown or light brown. The same general distribution of hair color prevails among the Iraq groups.

Although gray and white heads were frequently observed, they were invariably among the older men. In general graying begins fairly late in life among all the Syrians. The same is true for baldness.

The color of the beard and mustache is similar to the head hair in the Syrians and Transjordanians. In the Rif, however, Coon ('31, pp. 264–265) points out that the beards are frequently much lighter in color than the head hair, and due to the fact that the head hair is usually covered and beards are exposed, travellers have gotten the impression that Riffians are much blonder than they really are.

Eye color. Almost all the Howeitat eyes are dark brown (92.7), but the Beni Sakhr eyes are distributed over several colors: light brown 50.0, dark brown 36.7 and dark-light brown 11.7%. Although black and dark brown eyes are in the majority among the Syrian Bedouin (minimum, Akeydat 51.9, maximum, Maualy 74.6%), eyes of mixed shades are very common. For example, among the Rwala the following percentages occur: Gray-brown 22.2 and blue-brown 5.6, and among the Akeydat, gray-brown 32.3 and blue-brown 11.8. Among the desert border and mountain groups dark brown eyes range from 40.9 for Bekaā to 60.0% for Hama. Light brown eyes are especially prevalent among some of these groups and vary from 7.8 for Alouite to 30.9% for Bekaā. As with some of the Syrian Bedouin, eyes of mixed color are frequently seen, for example, the Hafar and Mitwali percentages are: green-brown 13.2 and 10.0, gray-brown 13.2 and 4.3, blue-brown 7.7 and 5.0. Pure blue eyes were noted twice among the Maualy but not among any of the other Bedouin. Along the desert border and among the Lebanese blue eyes range from 1.7 for Mitwali to 6.5% for Alouite.

Dark brown eyes are less frequent in the Rif than among Syrians, and range from 22.9 for Total Rif to 43.6% for Shluh. Light brown eyes are common, ranging from 11.7 for

Senhaja to 27.5% for Shluh. Eyes of mixed color are very prevalent and some of the percentages are: Total Rif and Ghomara, gray-brown 18.8 and 13.7, green-brown 23.3 and 34.2, blue-brown 13.2 and 9.6. In spite of considerable blondism in the Rif, blue eyes were always less than 2%.

For eye color among the Iraq groups the Kish Arab distributions may be cited: dark-brown 76.6, green-brown 12.0, blue-brown 8.3 and gray-brown 2.5%.

Seltzer ('36) in his study on Syrians and Armenians considers that the basic element in the Armenian series is the light brown-eyed type.

Hair form. Among the Transjordan Bedouin hair form is variable; the percentages for Howeitat and Beni Sokhr are, straight 36.2 and 13.3, low waves 21.7 and 35.0, deep waves 17.4 and 21.7, curly 21.7 and 30.0. Typical of the Syrian Bedouin is the Rwala distribution: straight 69.0, low waves 23.9 and deep waves 6.2%. Among the desert border and mountain groups straight hair ranges from 18.2 for Mitwali to 78.5 for Alouite, low waves from 14.7 for Alouite to 65.9 for Mitwali, and deep waves from 3.3 for Hafar to 15.6% for Mitwali. In no case did curly hair exceed 3% among the Syrian groups.

The Riffians are strikingly different from the above groups for they have high percentages of curly heads, ranging from a minimum of 43.3 for Senhaja to a maximum of 64.3 for Sheshawen. Like the Syrian and Transjordan males, the hair of the Kish Arabs of Iraq has but low waves or is straight: low waves 85.0, straight 4.6, deep waves 5.4, curly 4.6%.

Hair texture. The distribution of hair texture among the Howeitat and Beni Sakhr is: coarse 60.9 and 37.3, medium 10.1 and 23.7, fine 29.0 and 39.0%. Observations on hair texture were not noted on the Syrians. In the Rif nearly all the hair is medium to fine, for example, the Senhaja distribution is: coarse 2.6, medium 76.0 and fine 21.4%. The Kish Arab hair texture distribution is: coarse 12.7, medium 63.6, medium-fine 1.7 and fine 22.0%.

Hair quantity. Among the Transjordan and Syrian groups the head hair is medium in quantity, for example, Howeitat, submedium 29.0, medium 42.0 and pronounced 29.0%. However, the quantity of hair in the Bedouin beard is distinctly below the average; the distributions for Howeitat and Beni Sakhr respectively are: very small 13.4 and 13.6, submedium 44.8 and 39.0, medium 29.8 and 27.1, pronounced 10.4 and 18.6%. Coon says that the Riffians have on the whole slightly less hair on the mustache than do Europeans by and large, but not greatly so. The Kish Arabs, according to Field, have relatively heavy beards: minus 29.0, average 7.8, plus 34.9 and double plus 22.7%. Body hair among the Bedouin is below the average; Howeitat and Beni Sakhr: absent 14.8 and 0, submedium 66.7 and 33.3, medium 14.8 and 61.1, pronounced 3.7 and 5.6%. Among the Riffians body hair is less developed than that of Europeans, although there are considerable variations between the groups: two of the groups, Arabs and Shluh, show but little development of the body hair. The Rif Arabs and Shluh distributions are: absent 48.8 and 51.8, submedium 19.5 and 28.8, medium 19.5 and 13.5, pronounced 9.7 and 4.1, very pronounced 1.2 and 1.8%. The Kish Arabs apparently have more abundant body hair: minus 19.7, average 22.9, plus 44.6, double plus 10.0%.

Eye opening height. Coon ('39, p. 136 and fig. 26) calls attention to the fact that some of the past Near East races such as the Hittites, according to bas-relief sculptures, had an open-eyed type of countenance. Among the Transjordan Bedouin practically all of the eye opening heights were submedium or medium.

Eyebrow thickness. The Bedouin eyebrows are only moderately thick, for example, the Howeitat distribution is: submedium 20.6, medium 72.1, pronounced 7.3%. The Riffians have slightly heavier eyebrows, for example, Total Rif: submedium 5.3, medium 75.6, pronounced 19.2%. The distribution for the Kish Arabs is: minus 22.2, average 11.1, plus 41.3 and double plus 25.4%.

Eyebrow concurrency. Eyebrow concurrency among the Howeitat and Beni Sakhr is usually absent or of submedium development; its distribution for Beni Sakhr is: absent 46.5, submedium 41.4, medium 12.1%. Coon says there is but little eyebrow concurrency in Morocco; however it is rather common in Iraq for among the Kish Arabs 64.6% are recorded as plus or double plus.

Nasal bridge height. The nasal bridges of the Transjordan Bedouin are high. The distribution for this character is for Howeitat and Beni Sakhr: submedium 2.9 and 3.4, medium 43.5 and 48.3, pronounced 53.6 and 43.1, very pronounced 0 and 5.2%. The Riffian nasal bridge heights are somewhat similar, for example, the distribution for Total Rif: submedium 6.6, medium 66.9, pronounced 26.1 and very pronounced 0.2%. The Transjordan nasal bridge breadths are also usually medium or pronounced.

Nasal profile. The distribution of nasal profile for the Howeitat and Beni Sakhr is: concave 8.7 and 7.0, straight 62.3 and 61.4, convex 26.1 and 29.8%. The following percentages of straight noses were noted among the Syrian Bedouin: Rwala 91.4, Maualy 97.0 and Akeydat 79.6. Among the desert border and mountain dwellers straight noses vary from a minimum of 32.3 for Hidjaneh to a maximum of 92.3% for Hama, and convex noses from 5.3 for Hama to 52.2% for Hidjaneh. Concave noses were seen most frequently in Hafar, 7.7%. The Senhaja nasal profile distributions are representative of the Riffian groups: concave 13.3, straight 40.8, convex 41.3 and concavo-convex 4.6%. The Kish Arabs have the following percentages for nasal profile: straight 57.6, convex 20.1, concavo-convex 11.3 and concave 11.0.

Nasal wings. The nasal wings of the Transjordan Bedouin are practically all medium or compressed, the same is true of the Syrian Bedouin. Most of the desert border and mountain groups have noses of medium thickness. Nasal wing distributions for two of these groups, Mitwali and Hama, are: compressed 4.3 and 10.6, medium 91.1 and 73.5, flaring 4.6 and 15.9%. The Riffian extremes for nasal wings are

represented by Total Rif and Shluh: compressed 31.6 and 10.9, medium 64.2 and 73.1, flaring 4.2 and 16.0%. The Kish Arabs have the following percentages: compressed 12.3, medium-compressed 4.6, medium 58.5, medium-flaring 10.9, and flaring 13.7.

Measurements and indices

Stature. The Beni Sakhr-Howeitat significance ratio [5] for stature is 0.44, and their mean statures are Beni Sakhr 163, Howeitat 163 cm.[6] The Transjordan Bedouin, like the Rwala (mean 162) are short as compared to the Akeydat and Maualy who are both tall, means 168 and 170.[7] As in the desert, statures along the desert border are variable: Hama and Hidjaneh represent the shorter groups, 164 each, Hafar and Mhardeh the taller, 168 each. The mountain groups are of intermediate stature ranging from 165 for Bekaā to 167 for Mitwali. The Riffians are also of intermediate stature ranging from Sheshawen 164 to Total Rif 169. In Iraq two of the groups, Kish Arabs (168) and Ba'ij Bedouin (168) are of intermediate

[5] The significance ratio $= \dfrac{\Delta m - m^1}{\sqrt{(P.E._m)^2 + (P.E._m 1)^2}}$, or the difference of the means expressed in terms of the square root of the sum of the squares of the probable errors of the means. The purpose of the significance ratio is to determine in how far it is likely, on the basis of the laws of chance, that sample A and sample B might have been drawn at random from a single population. Its utility is to determine, therefore, whether samples A and B are entitled to separate consideration and mutual comparison, and it cannot be interpreted as a measure of the degree of racial difference.

Thus, for example, a significance ratio of 3.50 (table 4, first column, fourth row, Howeitat-Beni Sakhr head lengths) denotes that the observed difference in means is 3.50 times its probable error and the normal probability table shows that a difference as large or larger than this may be expected by random fluctuation to occur less than once in 100 samples.

The inference is that they are related; it is a necessary but not sufficient reason for not being closely related. The significance ratios for the various groups are presented in table 4 below.

[6] In this and the following pages the terms millimeters, centimeters and per cent are usually omitted as it is obvious to the reader what is intended.

[7] All significance ratios between the Syrian Bedouin and other groups are determined from the means and their probable errors as published by Shanklin and Izzeddin ('37, table 22), and by Shanklin ('38, table 24).

height, but the Iraq Soldiers (173) are very tall for the Near East.

Span. Like stature, span is variable for the groups under consideration. The Beni Sakhr-Howeitat significance ratio for span is relatively high 4.44,[8] their means are 170 and 173 respectively. Spans are not available for the Rwala nor the Iraq groups. The Akeydat (175) and Maualy (177) spans are relatively high, the same is true for some of the desert border groups (Hafar 175 and Mhardeh 177), but others are lower (Hidjaneh 173). Spans for the mountain groups range from 174 for Bekaā to 176 for Alouite. The Riffian spans all range from 172 for Sheshawen and Ghomara to 175 for Total Rif and Rif Arabs.

Relative span (stature-span index). The mean Beni Sakhr relative span is 104.3 and that for Howeitat is 106.6. The Akeydat (103.8) and Maualy (104.4) relative spans are similar, the same is true for most of the desert border groups: Hafar 104.4, Hidjaneh 105.2, Mhardeh 105.5, Hama 106.0, and for the mountain dwellers, Mitwali 104.6, Bekaā 105.4 and Alouite 105.7[9]. The Riffians have very constant relative spans, ranging from 104.0 for Rif Arabs to 104.4 for Shluh, except Sheshawen with a mean of 105.2.

Sitting height. The Beni Sakhr-Howeitat significance ratio for sitting height is 1.31 and their means are 83 and 85 respectively. The significance ratios for sitting height between Beni Sakhr and some of the Syrian and Riffian groups are of a significantly low order; those 3 or below are with

[8] Significance ratios of 3 and below will be considered as of a significantly low order, those 3 to 4 of a relatively high order, and those above 4 as of a high order.

[9] Some of the indices included in this paper were calculated from the means of data previously published by the writer, ('35, '36, '38), by Coon ('31), and by Field ('35). The indices calculated from these sources are: relative spans, length-height indices, breadth-height indices for all the Syrian groups, except Rwala; cephalic modules for the Riffians, fronto-parietal indices for all Syrian groups; cephalo-facial indices for all the Syrian and Iraq groups; zygo-frontal indices for all the Syrian groups; fronto-gonial indices and zygo-gonial indices for all the Syrian and Riffian groups; and upper facial indices for the Syrian mountain and desert border groups.

Rwala, Hama, Ghomara, Shluh and Ba'ij Bedouin; 3 plus to 4 Sheshawen and Kish Arabs. In the Syrian desert the Rwala have very low sitting heights, mean 83, but the Akeydat and Maualy have very high means, 86 and 87. Along the desert border, sitting heights, like stature, are variable, with Hama 84 the lowest. The remaining groups are Mhardeh 84 and Hafar, 87 Among the mountain groups Alouite and Bekaā (means 86) are lowest and Mitwali (88) is the highest. In the Rif the sitting heights are 83 for Ghomara and Shluh, 85 for the remaining Riffians. The sitting heights of two of the Iraq groups, Kish Arabs (82) and Ba'ij Bedouin (83) are low, but the Iraq Soldiers (85) are intermediate.

Relative sitting height. The significance ratio for relative sitting height or sitting height index between Beni Sakhr and Howeitat, mean 2.96, is of a low order. Their mean indices are Beni Sakhr 51.2 and Howeitat 51.7. The inter-group significance ratios between Beni Sakhr and a number of groups are low for this index: 3 or below with Rwala, Mhardeh, Hama, Alouite, Total Rif, Senhaja, Rif Arabs; above 3, Ghomara and Sheshawen. The extreme mean relative sitting heights of the above groups are from 50.5 for Ghomara to 51.7 for Howeitat. The Akeydat and Maualy, each 50.5, and the three Iraq groups (Kish Arabs 49.0, Iraq Soldiers 49.2, Ba'ij Bedouin 49.5) all have much lower relative sitting heights. Some of the desert border and mountain groups have very high sitting height indices; among the higher ones are Hidjaneh 52.6, Mitwali 52.8.

This rather wide range in relative sitting heights, from 49.0 for Kish Arabs to 52.8 for Mitwali reflects the extreme variations in body proportions between these groups. Coon, '39, p. 410) considers a relative sitting height of 51, which incidentally is lower than that of most Europeans, a standard Mediterranean character.

Head length. The outstanding characteristic of these groups is the extreme range of head length: shortest, Mitwali, 176; longest, Total Rif, Rif Arabs and Sheshawen, 194 each. This wide range is also reflected in the very high significance

ratios for head length, for example, Mitwali-Rwala 54.37. The Beni Sakhr-Howeitat significance ratio for head length is 3.50 and their means are 190 and 192 respectively. The Beni Sakhr inter-group ratios for head length are significantly low for a number of groups, those below 3 are: Rwala, Akeydat, Maualy, Hafar, Ghomara, Kish Arabs and Ba'ij Bedouin. Those longer headed than Beni Sakhr among the Riffians are: Shluh and Senhaja, 193 each; Rif Arabs, Total Rif and Sheshawen, 194 each. The Iraq Soldiers have shorter heads (187), as do most of the desert border dwellers, 184 for Mhardeh and Hidjaneh, and 185 for Hama.

Head breadth. Like head length there is also a wide range in head breadth for these groups, the extremes are represented by the Ba'ij Bedouin 140 and the Mitwali 153. The Beni Sakhr-Howeitat significance ratio for head breadth is 4.92 and their means are 142 and 145. For head breadth, the Beni Sakhr intergroup ratios are significantly low for the following groups: Rwala, Hama, Hafar, Hidjaneh, Shluh, Iraq Soldiers, Kish Arabs and Ba'ij Bedouin. The means for this group range from 140 for Ba'ij Bedouin to 144 for Rwala, Hama, Shluh, and Iraq Soldiers. The Akeydat and Maualy Bedouin have relatively broad heads, 146 and 147. The Mhardeh men, as well as the Lebanese, all have broader heads and range from 147 for Mhardeh to 153 for Mitwali. The Riffian head breadths range from 144 for Shluh to 149 for Sheshawen.

Cephalic index. Kappers and Parr ('34) published in their book, "An Introduction to the Anthropology of the Near East," many graphs based on the distribution of cephalic indices for various Near East groups. Their graphs show in a striking manner the remarkable differences that exist between the mountain groups, the desert border groups, and the Bedouin. There is perhaps not another place in the world where such a marked range in cephalic indices can be obtained in such a short distance, less than 100 miles, as from Beirut to Damascus and the surrounding desert. The mountain groups are hyper-brachycephalics, for example, the Mitwali,

mean cephalic index 87.4, along the desert border there are subbrachycephalics and mesocephalics such as Mhardeh 79.9, Hama 78.7, and in the desert dolicocephalics such as Beni Sakhr and Rwala with 74.9 and 75.0 respectively.

The Beni Sakhr-Howeitat significance ratio for cephalic index is low (1.61) and their means are 74.9 and 75.5. The Beni Sakhr have significantly low ratios for cephalic indices with a number of other groups, Rwala, Hafar, Total Rif, Senhaja, Rif Arabs, Shluh, Kish Arabs and relatively low ratios with the Ba'ij Bedouin. Between all these groups the mean cephalic index range is from 73.4 for Ba'ij Bedouin to 75.9 for Hafar. The Akeydat and Maualy Bedouin, like the Iraq Soldiers and the desert border groups, are all mesocephalics ranging from 76.4 for Akeydat to 79.9 for Mhardeh.

In the earlier study (Shanklin, '34) on head-form among Transjordanians the mean cephalic index for all the groups was 77.3 and the range was from 74.1 for Beni Atiyeh, one of the Bedouin tribes, to 78.8 each for two of the villages, Aidoun and Nuaimi.

Head height. The Beni Sakhr-Howeitat significance ratio for head height is significantly low, 0.44, and their means are 124 and 123. The Akeydat and Maualy have means of 123 and 125. Head heights are not available for the Rwala nor the Iraq groups. The desert border head heights range from 124 for Hidjaneh to 127 for Mhardeh. The Mitwali (mean 129) have the highest heads of any of the Syrian groups. On the average the Riffians have slightly higher heads than the Syrian groups. They range from 126 for Shluh to 129 for Senhaja, Total Rif and Sheshawen.

Length-height index. The Beni Sakhr head length-height index is 65.2 and the Howeitat is 64.1. The other two Bedouin groups have similar length-height indices, Akeydat 64.2 and Maualy 65.8. The desert border groups have length-height indices intermediate between those of the Bedouin and the Lebanese. The desert border indices are: Hafar 66.1, Hama 67.2, Hidjaneh 67.4, Mhardeh 68.7. The mountain groups are: Alouite 69.8, Bekaā 71.8, Mitwali 73.5. The length-height in-

dices of the Riffian groups are nearest to those of the desert border groups and they range from 65.4 for Shluh to 67.1 for Ghomara.

Breadth-height index. The Beni- Sakhr head breadth-height index is 86.5, the Howeitat 85.0, the Akeydat 84.0, and Maualy 85.2. The desert border groups have higher averages: Mhardeh 86.2, Hama 87.1, Hafar and Hidjaneh 87.3 each. The mountain groups, Alouite, Bekaā, and Mitwali, each has a mean breadth-height index of 84.7. Nearly all the Riffian mean breadth-height indices fall between minimum Sheshawen 86.9 and maximum Senhaja 89.1.

Cephalic module. Cephalic module, which is obtained by adding the three head measurements, length, breadth, and height and dividing by three, gives some idea of the relative head size. The Beni Sakhr-Howeitat significance ratio for cephalic module is 3.70 and their means are 152 and 154. The Akeydat mean is 153 and the Maualy 154. The desert border dwellers range from 150 for Hidjaneh to 153 for Mhardeh and for Hafar. Although the mountain groups are short instead of long headed, actually in size they are similar to the other groups, Alouite 151, Bekaā and Mitwali 152 each. The Riffians tend to have slightly larger heads and range from a mean cephalic module of 154 for Shluh to 158 for Sheshawen. Cephalic modules are not available for the Iraq groups, but Sir Arthur Keith calls attention, in the volume by Field ('35), to the small size of the Bedouin head. Of the thirty-eight Bedouin heads, Keith classifies thirteen as small, twenty-four as medium sized and only one as large, furthermore, of thirty-five South Arabs from southern Arabia, he classifies thirty-three as small, two as medium and none as large. Coon ('39) includes head measurements on two groups from Yemen, the plateau Yemenis and the coastal Yemenis. The plateau Yemenis have a mean cephalic module of 152. Only the head length (mean 177) and head height (mean 122) are given for the coastal group, but Coon says they are smaller-headed than the plateau dwellers.

Minimum frontal diameter. The Beni Sakhr-Howeitat significance ratio for the minimum frontal diameter is 3.91 and their means are 104 and 106. The inter-group significance ratios for this measurement between the Beni Sakhr and the following groups are significantly low: Rwala, Hidjaneh, Senhaja, Ghomara, Rif Arabs and Shluh. All these groups have narrow minimum frontal diameters and range from 103 for Shluh and Hidjaneh to 105 for Senhaja and Ghomara. The desert border and mountain groups are intermediate and range from 106 for Bekaā to 110 for the Alouites. The Akeydat (110) and Maualy (111) both have very broad minimum frontal diameters, likewise the Iraq groups, 111 for the Kish Arabs and Ba'ij Bedouin and 114 for the Iraq Soldiers.

Fronto-parietal index. The mean Beni Sakhr fronto-parietal index is 72.9 and that of Howeitat is 73.1. Among the Syrian Bedouin, the Rwala mean 72.3 is similar to that of the Transjordan Bedouin, but the Akeydat and Howeitat have considerably higher means, 75.6 and 75.7. The desert border and the mountain group fronto-parietal indices are: Alouite 70.4, Bekaā 70.7, Mitwali 71.1, Hidjaneh 72.6, Mhardeh 73.5, Hafar 74.6 and Hama 75.5. The Riffians all have relatively low fronto-parietal indices and range within a very narrow zone, minimum Sheshawen 71.3, maximum Total Rif 72.9. The Iraq groups all have exceedingly high fronto-parietal indices: Kish Arabs 78.6, Iraq Soldiers and Ba'ij Bedouin 79.3 each.

Bizygomatic diameter. For this character the Beni Sakhr and Howeitat have means of 131 each. Narrow bizygomatics are also found among the Rwala, Hidjaneh, Hama, Shluh, Ba'ij Bedouin, and Kish Arabs. These groups range from 128 for the Ba'ij Bedouin to 132 for Hama and Shluh. For bizygomatic diameter most of the remaining groups are fairly uniform. The Akeydat and Maualy are 135 and 136. Except for Hama and Hidjaneh, the desert border and mountain groups range from 133 for Hafar to 135 for each of the three mountain groups, Bekaā, Mitwali, Alouite. The Riffian groups, excluding the Shluh, all have bizygomatic diameters of 135 or 136.

Cephalo-facial index. The mean cephalo-facial index for Beni Sakhr is 92.1 and for Howeitat 90.1 The Syrian Bedouin have similar means: Rwala 90.4, Akeydat 92.1, Maualy 92.4. Likewise the desert border groups are similar: Mhardeh 91.2, Hidjaneh 91.4, Hama 92.2, Hafar 92.8. The mountain groups tend to have lower cephalo-facial indices: Mitwali 88.6, Bekaā 89.8, Alouite 90.8. The Riffian groups are more like the Bedouin and the desert border groups and range from 91.4 for Sheshawen to 93.3 for Total Rif. The Iraq Soldiers are also similar: Kish Arabs 91.3, Ba'ij Bedouin 91.6 and Iraq Soldiers 93.2.

Zygo-frontal index. The mean Beni Sakhr zygo-frontal index is 79.6 and that for Howeitat is 80.7. The Syrian Bedouin means are: Rwala 80.0, Maualy 81.9 and Akeydat 82.1. The means of the desert border groups are: Hidjaneh 79.4, Hafar 80.4, Mhardeh 80.7 and Hama 82.3. The Lebanese means are similar: Bekaā 78.8, Mitwali 80.3 and Alouite 81.4. Nearly all the Riffians have lower zygo-frontal indices; they range from 77.1 for Shluh to 78.3 for Senhaja. Field ('35) who called this the jugo-frontal index found much higher indices: Iraq Soldiers 85.0, Kish Arabs 85.9, Ba'ij Bedouin 86.1.

Bigonial diameter. The Beni Sakhr mean bigonial diameter is rather low, 103, but that of the Howeitat, mean 105, is intermediate. The Beni Sakhr inter-group ratios are significantly low for bigonial diameter with the following: Hidjaneh, Senhaja, Ghomara, Sheshawen, Rif Arabs, Kish Arabs and Ba'ij Bedouin. The range for these groups is from 102 for Ba'ij Bedouin, Kish Arabs and Rif Arabs to 104 for Hidjaneh. The Shluh bigonials are very narrow, 100, but the remaining groups all have broad bigonial diameters: Rwala 105, Total Rif and Hafar 106, Hama, Mhardeh, Alouite and Iraq Soldiers each 107, Akeydat, Maualy and Bekaā 108 and the Mitwali 110.

Fronto-gonial index. The mean Beni Sakhr fronto-gonial index is 99.2 and the Howeitat is 99.7. The Maualy have a mean of 97.1, the Akeydat 97.8 and the Rwala 101.7. The desert border and mountain groups are also rather variable: Alouite

97.3, Hama 97.8, Mhardeh 98.6, Hafar 99.1, Hidjaneh 100.7, Mitwali 101.4 and Bekaā 101.8. The Riffian fronto-gonial indices are similar to those of the Syrian groups: Shluh 97.2, Sheshawen 97.4, Senhaja 97.7, Rif Arabs 98.1, Ghomara 98.7 and Total Rif 100.0. The Iraq groups have far lower fronto-gonial indices: Kish Arabs 92.3, Ba'ij Bedouin 93.0 and Iraq Soldiers 93.8.

Zygo-gonial index. The mean zygo-gonial indices for the Transjordan Bedouin are: Beni Sakhr 78.5, Howeitat 80.2. The Syrian Bedouin have similar zygo-gonial indices: Maualy 79.5, Akeydat 80.3 and Rwala 81.4. Among the desert border dwellers this index has a very narrow range: Mhardeh 79.6, Hafar 79.7, Hidjaneh 80.0, Hama 80.5. The mountain groups have the following means: Alouite 79.2, Bekaā 80.2 and Mitwali 81.4.

Field ('35) calls this the jugo-mandibular index. He found this index very constant for the Iraq groups: Kish Arabs 79.2, Ba'ij Bedouin 79.5 and Iraq Soldiers 79.7. The Riffians all have much lower mean zygo-gonial indices due largely to the fact that their bigonial diameters are less than those of the other groups; their mean indices are: Arabs 75.8, Shluh 75.9, Sheshawen 75.9, Ghomara 76.4, Senhaja 76.4 and Total Rif 78.0.

Total facial height. The Howeitat have unusually short faces, mean 115, but those of Beni Sakhr are of intermediate length, 120. Significantly low ratios exist for total facial heights between Beni Sahkr and the following groups: Rwala, Hidjaneh, Hama, Mhardeh, Hafar, Mitwali, Senhaja, Ghomara, Iraq Soldiers and Kish Arabs. All of these range from 119 for Rwala to 122 for Hafar and Senhaja. Other groups have still longer faces varying from 123 each for Akeydat, Bekaā, Sheshawen, Rif Arabs to 124 each for Maualy and Total Rif.

Upper facial height. The Beni Sakhr-Howeitat significance ratio for upper facial height is 3.22 and their means are 69 and 67. Significance ratios of a significantly low order prevail for upper facial height between Beni Sakhr and the

following: Rwala, Hama, Mhardeh, Hafar, Hidjaneh, Bekaā, Mitwali, Ghomara, Sheshawen, and Shluh. All of these groups have mean upper facial heights of 69 or 70. The Akeydat and Maualy Bedouin have upper facial heights of 72 and 73. The highest for the Riffians is 72 for Total Rif, Senhaja and Rif Arabs. All three of the Iraq groups have high upper facial heights: 73 for Kish Arabs and 74 each for Iraq Soldiers and Ba'ij Bedouin.

Facial index. All of the facial indices of these groups fall in the leptoprosopic category, i.e., 88.0 to 92.9, hence are considered as long faces. The Beni Sakhr facial index is high, 91.6, but the Howeitat is only 87.9, their significance ratio is 5.87. The Beni Sakhr inter-group significance ratios for facial index with the Syrian Bedouin, the desert border, the mountain, the Riffian and the Iraq groups are all significantly low and their means fall within the narrow range of 89.6 for Mitwali to 92.7 for Kish Arabs.

Upper facial index. The Beni Sakhr upper facial index is 52.8 and the Howeitat 50.6. The Beni Sakhr upper facial index is near the average for all the groups. The Syrian Bedouin mean upper facial indices are: Akeydat 53.4, Maualy 53.8, Rwala 53.9; the desert border groups are: Mhardeh 51.8, Hafar 52.6, Hama 52.8, Hidjaneh 53.2 and the mountain groups are: Mitwali 52.0, Bekaā 52.2, Alouite 52.8. The Riffian groups range from 51.9 for Sheshawen to 53.4 for Rif Arabs and for Total Rif. The extremely high upper facial heights of the Iraq groups are responsible for their high upper facial indices: Iraq Soldiers 55.2, Kish Arabs 56.6 and Ba'ij Bedouin 57.4. The thirty-three Iraq Bedouin measured by Ehrich (Coon, '31, p. 242) also had a mean upper facial index of 57.4.

Nasal height. The Beni Sakhr-Howeitat significance ratio for nasal height is low, 2.74, and their means are 53 and 52 respectively. The Beni Sakhr inter-group significance ratios for nasal height are of a low order (3 or below) with many of the other groups: Hafar, Mhardeh, Hama, Mitwali, Alouite, Senhaja, Ghomara, Sheshawen, Rif Arabs, Shluh. All of these groups have nasal heights between 52 and 54. The Hidjaneh

and Bekaā males have shorter noses, 51 each. The Akeydat, Maualy, Rwala and Total Rif have slightly longer noses, 55 each. The Iraq groups in addition to having unusually long upper facial heights, also have very long noses: Iraq Soldiers 56.8, Kish Arabs 58.3, Ba'ij Bedouin 60.4.

Nasal breadth. The Beni Sakhr-Howeitat significance ratio (1.57) for nasal breadth is significantly low; their mean breadths are 33 and 34. Some of the other groups have nasal breadths around 33 and 34; these are Hidjaneh, Mitwali, Bekaā, Ghomara, and Iraq Soldiers.

All of the remaining groups have mean nasal breadths of 35, except Hama, Akeydat, Sheshawen with 36, and Maualy 37. The very broad noses of the Akeydat and the Maualy cannot be attributed to negro admixture as no other negro characteristics were noted among these tribesmen.

Nasal index. The nasal indices of nearly all these groups are very similar, except for the Iraq groups. The Beni Sakhr mean is 63.9, the Howeitat 66.3 and their significance ratio is 2.66. The Beni Sakhr have significantly low inter-group ratios for nasal index, with all the Bedouin tribes, all the Riffian groups, the Alouites, Mitwali and Bekaā. All of these range from 63.6 for Total Rif to 66.3 each for Maualy, Howeitat and Rif Arabs. Due to the unusually long noses of the Iraq groups their nasal indices are of a very low order and range from 58.4 for Ba'ij Bedouin to 61.1 each for the other two groups, Kish Arabs and Iraq Soldiers. All of the desert border groups have higher nasal indices; these range from 66.7 for Hidjaneh to 69.2 for Hafar. Most all of the above nasal indices fall well within the leptorrhine category of 69.9 and under.

DISCUSSION

The Beni Sakhr and Howeitat Bedouin are very similar in their measurements and they have the low mean significance ratio of 2.87.[10] Those characteristics in which these two differ

[10] Throughout this discussion the significance ratio will be the mean based on the significance ratio for each of the characters and indices. The significance ratios referred to are in table 4 of this paper or in the paper by Shanklin ('38, tables 27 and 28).

significantly are as follows: the Howeitat have greater spans than Beni Sakhr, longer and broader heads, broader bizygomatics and bigonials. Although the Beni Sakhr faces are narrower, they are the longer, both for the total and for the upper facial. Morphologically the Beni Sakhr are very similar to the Rwala Bedouin; their mean significance ratio is 2.27. Of the nineteen characters and indices compared between these two Bedouin tribes only three are significantly different: bigonial diameter, nasal height and nasal breadth. However the Howeitat-Rwala significance ratio (4.02) is relatively high. The Rwala have narrower heads than the Howeitat, but longer faces, as shown by higher total facial and higher upper facial heights, greater nasal heights and nasal breadths. The Howeitat sitting heights are significantly higher than those of the Rwala.

These three Bedouin tribes with the strikingly low statures, and so similar to each other, may be considered as members of the Mediterranean race proper, discussed at length by Coon ('39, pp. 84, 85, 292, 400–509). The measurements, indices and observations of these Bedouin; Beni Sakhr, Howeitat and Rwala, have been added together and the average for each determined.[11] This average will be considered as a composite Bedouin representing the short statured Mediterranean race proper as it is found in the Syrian and Transjordan deserts today. This composite Bedouin has the following measurements: stature 162.9, span 171.7, sitting height 83.7, relative span 105.5, relative sitting height 51.3, head length 191.3, head breadth 143.7, head height 123.6, cephalic index 75.1, length-height index 64.6, breadth-height index 85.8, cephalic module 152.0, minimum frontal diameter 104.8, fronto-parietal index 72.8, bizygomatic diameter 130.6, cephalo-facial index 90.9, zygo-frontal index 80.1, bigonial diameter 104.6, fronto-gonial index 100.2, zygo-gonial index 80.0, total facial height 118.1, upper facial height 68.6, facial index 90.4, and an upper facial index of 52.6. The nasal bridge is far above the average in

[11] Where measurements, indices or comparable observations are lacking on the Rwala, the average is based on the data for Beni Sakhr and Howeitat.

height, is usually straight and of medium width; the nose is actually a very large one, the nasal height is 53.2, nasal width 34.1 and the nasal index is 64.6. The ear height is 60.6, the ear breadth 32.7 and the ear index is 54.4.

The skin color of this composite Bedouin is most frequently medium brown, 47.2%, other shades are light brown 25.3, red-brown 13.3, yellow-brown 8.9, occasionally a brunet, chocolate or swarthy skin is noted. The hair occurs as low waves in 28.4%, straight in 24.8, deep waves 19.5 and curly in 25.9%. The hair is of medium texture. The head hair is of medium quantity but the quantity of facial hair is below the average for mankind, as shown by the following distribution: very small amount 13.5%, submedium 41.9, medium 28.5, pronounced 14.5 and very pronounced 1.6. The body hair is also very sparse. The hair color is most frequently dark brown or black: black 27.3, dark drown 52.9, brown 11.2, reddish-brown 12.1 and red 2.6%.

The eye color of this composite Bedouin is usually brown or brown mixed with other colors; the eye color distribution is: black 2.3, dark brown 65.0, dark-light brown 4.8, light brown 17.6, gray brown 8.0, and blue-brown 1.9%. Some other characteristics of this Bedouin are: submedium to medium eye opening heights, submedium to medium eyebrows, the same is true for eyebrow concurrency and the browridges. The nasal depression tends to be more on the submedium side, but the nasal root breadth is medium. The nasal root height is frequently above medium for 36.5% are pronounced and 9.7% are very pronounced. The nasal bridge heights are nearly all medium or pronounced. They are 46.4 and 48.4% respectively. The nasal bridge breadths follow the same pattern. The nasal profile is most frequently straight, 71.7%; other forms are convex 20.2, concave 6.5. The nasal tip is of medium or pronounced thickness, and frequently is inclined downward. The nasal wings are invariably compressed or are of medium width.

Our next problem will be to determine in what ways these short statured Bedouin differ from their neighbors, the tall

Akeydat and Maualy Bedouin. The high mean significance ratios between these groups brings out in a striking manner their dissimilarity: Beni Sakhr-Akeydat 4.91, Beni Sakhr-Maualy 6.77, Howeitat-Akeydat 4.85, Howeitat-Maualy 7.03, Rwala-Akeydat 5.45 and Rwala-Maualy 9.84.

The characters and indices that describe the short-statured Bedouin (Beni Sakhr-Howeitat-Rwala) are now compared with the average of the Maualy-Akeydat, or the composite tall-statured Bedouin. The former stature is 162.9, the latter 169.3. Stating the Maualy-Akeydat average first, and then the Beni Sakhr-Howeitat-Rwala average, the following measurements are noted: spans 176.2 and 171.7, relative spans 104.1 and 105.5, sitting heights 86.4 and 83.7, relative sitting heights 50.5 and 51.3, head lengths 190.8 and 191.3, head breadths 146.5 and 143.7, head heights 124.1 and 123.6, cephalic indices 76.8 and 75.1, length height indices 65.0 and 64.6, breadth height indices 84.6 and 85.8, cephalic modules 153.8 and 152.0, minimum frontal diameters 110.5 and 104.8, fronto-parietal indices 75.6 and 72.8, bizygomatic diameters 135.5 and 130.6, cephalo-facial indices 92.3 and 90.9, zygo-frontal indices 82.0 and 80.1, bigonial diameters 108.7 and 104.6, fronto-gonial indices 97.5 and 100.2, zygo-gonial indices 79.9 and 80.0, total facial heights 123.7 and 118.1, upper facial heights 72.4 and 68.6, facial indices 92.1 and 90.4, upper facial indices 53.6 and 52.6, nasal heights 55.0 and 53.2, nasal breadths 36.5 and 34.1, nasal indices 66.1 and 64.6, ear heights 62.3 and 60.6, ear breadths 32.5 and 32.7, ear indices 52.2 and 54.4.

We will summarize the comparative anthropology of these two varieties of Mediterraneans briefly. In their observable characteristics both are very similar, but morphologically the tall variety, Maualy and Akeydat, are larger in every character measured than the short variety, Rwala, Beni Sakhr and Howeitat. The tall stature and large size of the Maualy and Akeydat Bedouin suggests that they belong to the old Megalithic Mediterranean race, representatives of which migrated from the Near East, during Neolithic times, and settled around the shores of the Mediterranean as far as the Straights of

Gibraltar. These megalith or dolmen builders later on became known as the Atlanto-Mediterranean race and today include most of the peoples of northwest Africa. For a full discussion of this problem the reader is referred to Coon ('39, p. 727 on the subject index).

A comparison of the Rwala, Beni Sakhr and Howietat shows that in all cases the significance ratio is above 3 when compared with the desert border groups. The lowest inter-group significance ratio is that for Beni Sakhr-Hidjaneh 3.39, but even they are significantly different in eight characters out of twenty-one. The Hidjaneh are slightly larger men than the Beni Sakhr; they have significantly higher sitting heights, higher sitting height indices, longer spans, higher cephalic indices, broader minimum frontal diameters, and higher nasal indices, but the Beni Sakhr have longer and also larger heads, as shown by the higher cephalic modules. Comparing the other desert border groups with the Beni Sakhr, the mean inter-group significance ratios are Beni Sakhr-Hama 3.71, Beni Sakhr-Hafar 3.87, Beni Sakhr-Mhardeh 6.05. The Howeitat desert border group mean significance ratios range from Howeitat-Hafar 3.92 to Howeitat-Mhardeh 5.89, the Rwala desert border mean significance ratios range from Rwala-Hafar 5.46 to Rwala-Mhardeh 8.06. The greatest dissimilarity between representatives of these two groups is between Rwala and Mhardeh. They have significantly high ratios for thirteen out of eighteen characters. They are significantly different in the following characters and indices: Mhardeh men are much taller, 168, than Rwala 162; they have much higher sitting heights, 86 and 83, greater head breadths 147 and 144, higher cephalic indices 79.9 and 75.0, broader minimum frontal diameters 108 and 104, broader bizygomatic diameters 134 and 130, higher facial heights 121 and 119, higher nasal indices 67.1 and 63.7, greater ear heights 63.5 and 60.5; the Rwala have higher total facial indices 91.7 and 90.2, longer heads 191 and 184, longer noses 55 and 53 and greater ear indices 55.0 and 52.7. In brief the

Mhardeh males, like those of Hidjaneh, are larger in nearly every character than the Rwala.

Significance ratios were not determined between the Beni Sakhr, the Howeitat and two of the mountain groups, Mitwali and Bekaā, hence the Rwala will be compared with the Mitwali to contrast the short-statured Mediterraneans with the Lebanese mountaineers. The Mitwali-Rwala mean significance ratio is exceedingly high 18.39, and out of eighteen characters and indices fourteen are significantly high. The individual characters and indices in which the Mitwali are significantly higher than the Rwala are: stature 167 and 162, sitting heights 88 and 83, sitting height indices 52.8 and 51.1, head breadths 153 and 144, minimum frontal diameters 109 and 104, bizygomatic diameters 135 and 130, bigonial diameters 110 and 105, total facial heights 121 and 119, ear heights 61 and 60. The Rwala exceed the Mitwali in head length 191 and 176, total facial indices 91.7 and 89.6, nasal heights 55 and 53, nasal breadths 35 and 34. In other words the mountain groups like the desert border groups are much larger men than the short-statured variety of the Mediterranean race as represented by the Rwala, the Beni Sakhr and the Howeitat.

Coon ('39) proposes an interesting hypothesis to explain the "Principle of Dinaricization" whereby certain long-headed races have been changed to brachycephalics. The principle as he elucidates it states "A mixture of a Mediterranean stock with a 33%, more or less, solution of Alpine may bring about a differential inheritance of the majority of the offspring." On this basis Coon explains the formation of the hyperbrachycephalic Lebanese. The study of these Syrian groups suggests that if such a Mediterranean-Alpine cross occurred it must have been largely with the tall-statured Mediterraneans rather than with the short-statured Mediterraneans proper.

Coon ('39, pp. 294 and 295) includes nearly all of the inhabitants of Morocco as members of the Atlanto-Mediterranean race. In order to determine whether or not the Syrian and Transjordan groups were in any way similar to the

peoples of Morocco significance ratios were worked out between them and the Riffians (Total Rif, Senhaja, Ghomara, Sheshawen, Rif Arabs, Shluh) measured by Coon ('31).

For each character and index Coon ('31) publishes the "Difference of Means Equals X Times Probable Error," which is worked out by the same formula and corresponds exactly to the term "significance ratio" as defined and used in this paper. Coon (p. 327) includes a table showing the dispersion values of X. P.E. in thirty-one characters; references to the mean X.P.E. or significance ratio will be based on this table. Many of the Riffian inter-group mean significance ratios are 3 or below: Total Rif-Senhaja 2.60, Total Rif-Rif Arabs 2.54, Senhaja-Ghomara 2.68, Senhaja-Rif Arabs 2.00, Ghomara-Sheshawen 2.73, Ghomara-Arabs 2.96 and most of the remaining groups have relatively low ratios ranging from 3 to 4: Total Rif-Ghomara 3.88, Total Rif Sheshawen 3.21, Senhaja-Sheshawen 3.23, Ghomara-Shluh 3.64, Sheshawen-Rif Arabs 3.02, Rif Arabs-Shluh 3.16 and Sheshawen-Shluh 4.00. Those above 4 are: Senhaja-Shluh 5.13 and Rif-Shluh 6.21. As Coon points out (p. 328) the Riffians and the Shluh are mutually the most distant. Further analysis of the Rif data indicates that these Riffians fall into three-major groups. At one extreme is Total Rif, intermediate are Senhaja, Sheshawen, Ghomara and Rif Arabs, at the other extreme is Shluh. The inter-group significance ratios for the intermediate group, Senhaja, Sheshawen, Ghomara and Arabs, all fall between 2.00 and 3.23.

The Beni Sakhr-Riffian significance ratios (table 4) are: Beni Sakhr-Ghomara 3.05, Beni Sakhr-Sheshawen 3.46, Beni Sakhr-Shluh 3.50, Beni Sakhr-Rif Arabs 3.85, Beni Sakhr-Senhaja 4.02, Beni Sakhr-Total Rif 5.64. It is obvious that the Beni Sakhr are more like the Shluh and those Riffians of the intermediate group farthest away from Total Rif and Senhaja. The Howeitat Bedouin are far more dissimilar to the Riffians than the Beni Sakhr are for only one of the mean significance ratios falls below 4; Howeitat-Sheshawen 3.66, the others fall between Howeitat-Ghomara 4.73 and Howeitat-

TABLE 4

Significance ratios for Transjordanian, Syrian, Riffian and Iraqqian males.

	HOWEITAT-BENI-SAKHR	HOWEITAT-RWALA	HOWEITAT-AKEYDAT	HOWEITAT-MAUALY	HOWEITAT-HIDJANEH	HOWEITAT-HAFAR	HOWEITAT-HAMA	HOWEITAT-MHARDOH	HOWEITAT-ALOUITE	HOWEITAT-TOTAL RIF	HOWEITAT-SENHAJA	HOWEITAT-GHOMARA
Stature	0.44	2.43	9.48	13.69	2.69	7.83	1.65	11.28	7.36	12.39	8.19	3.59
Sitting height	1.31	2.00	2.62	5.70	4.93	4.90	0.68	9.88	2.13	1.24	0.71	4.21
Span	4.44		2.10	6.60	1.09	2.69	0.40	5.82	4.45	3.55	1.69	1.42
Head length	3.50	1.74	1.69	3.32	13.65	4.20	13.76	13.25	24.25	4.04	0.83	3.07
Head breadth	4.92	3.43	2.11	4.32	6.01	3.52	3.19	4.16	7.70	1.64	0.64	2.88
Head height	0.44		1.39	4.28	1.95	3.59	3.73	7.30	3.29	13.71	11.74	7.31
Minimum frontal diameter	3.91	4.98	8.12	10.47	8.49	1.37	5.70	4.17	7.49	0.09	1.85	2.83
Bizygomatic diameter	1.11	2.86	5.81	9.28	1.88	3.18	2.43	5.16	7.62	10.48	6.99	6.59
Bigonial diameter	3.75	0.55	5.03	5.67	2.22	1.41	2.63	2.75	3.21	1.91	4.55	3.05
Total facial height	6.48	6.81	12.56	14.32	7.90	10.14	10.45	9.21	12.34	16.33	11.96	8.65
Upper facial height	3.22	7.12	10.00	13.45	8.08	6.30	6.58	5.29	10.31	13.79	10.57	6.55
Nasal height	2.74	9.91	6.52	10.21	2.82	0.00	2.55	3.26	6.63	9.28	4.05	4.25
Nasal breadth	1.57	9.33	9.22	10.54	1.63	4.42	6.64	4.98	4.21	3.05	2.70	0.17
Ear height	1.00	0.21	3.46	4.71	0.16	6.17	2.64	6.60	3.60			
Ear breadth	0.47	1.92	0.37	1.39	2.20	0.51	0.41	2.61	2.37			
Relative sitting height	2.96	4.13	7.31	7.92	6.87	3.21	3.33	2.72	1.58	5.69	4.80	6.92
Cephalic index	1.61	1.90	2.91	6.19	7.03	1.21	8.10	14.01	24.15	1.91	1.31	4.86
Cephalic module	3.70		1.00	1.62	10.18	2.54	5.56	2.64	9.57			
Length height index	3.44									10.03	9.22	8.64
Breadth height index	4.30									11.19	11.19	4.63
Fronto-parietal index	0.48									0.65	0.72	4.22
Cephalo-facial index	4.83									10.52	8.90	5.77
Zygo-facial index	3.00									8.55	7.50	9.06
Facial index	5.87	7.50	6.57	8.68	7.68	6.66	7.16	4.19	6.07	7.37	5.17	3.14
Upper facial index	4.68									8.12	6.66	3.62
Nasal index	2.66	4.42	0.57	0.13	0.56	3.75	2.89	1.16	2.11	4.86	2.17	3.31
Ear index	0.76	1.20	2.94	5.12	0.93	4.67	1.73	3.19	5.02			
Average	2.87	4.02	4.85	7.03	4.71	3.92	4.39	5.89	7.40	6.97	5.40	4.73

TABLE 4 — (*continued*)

	HOWEITAT-SHESHAWEN	HOWEITAT-RIF ARABS	HOWEITAT-SHLUH	HOWEITAT-KISH ARABS	HOWEITAT-IRAQ SOLDIERS	HOWEITAT-BAIJ BEDOUIN	BENI-SAKHR-EWALA	BENI-SAKHR-AKEYDAT	BENI-SAKHR-MAUALY	BENI-SAKHR-HIDJANEH	BENI-SAKHR-HAFAR	BENI-SAKHR-HAMA
Stature	1.35	8.15	4.83	7.79	20.17	7.42	1.45	8.41	11.63	2.63	7.18	1.83
Sitting height	0.12	1.34	4.90	9.41	0.06	3.42	1.97	5.89	8.75	8.19	7.53	0.87
Span	1.47	1.63	1.60					6.25	10.39	4.15	6.69	5.12
Head length	2.28	2.96	1.12	7.30	8.94	1.43	2.75	2.20	0.86	9.23	0.46	8.39
Head breadth	5.21	0.02	3.11	8.00	3.30	6.41	2.64	7.63	10.31	0.07	1.70	3.09
Head height	6.56	7.23	6.04					1.84	3.67	1.35	3.05	3.16
Minimum frontal diameter	0.14	3.12	6.80	10.98	16.34	6.82	0.61	13.04	16.01	1.47	5.82	10.68
Bizygomatic diameter	7.11	7.18	1.99	3.57	5.23	3.56	1.60	7.22	11.13	0.57	4.48	3.83
Bigonial diameter	1.97	4.60	10.12	5.45	3.02	4.74	6.82	8.68	9.42	2.57	5.38	6.52
Total facial height	8.87	11.81	7.99	8.31	9.85	2.65	1.42	4.42	5.63	0.82	2.70	1.99
Upper facial height	5.56	9.66	7.76	13.20	16.18	11.39	2.18	5.27	7.84	0.85	2.00	1.93
Nasal height	4.67	4.87	4.25	18.89	13.87	15.86	7.16	3.53	6.15	5.96	2.55	0.84
Nasal breadth	4.47	5.50	5.71	6.01	2.56	2.72	5.45	9.01	10.17	0.61	5.22	6.94
Ear height				4.41	1.86	3.81	1.13	2.53	3.82	1.20	5.43	1.56
Ear breadth				10.71	13.34	11.13	1.99	0.79	0.55	2.18	0.90	0.84
Relative sitting height	1.67	4.94	8.41	19.56	15.70	8.38	0.51	4.10	4.44	10.59	6.30	0.00
Cephalic index	2.49	2.67	3.52	0.89	3.81	4.54	0.22	4.80	8.18	9.02	3.03	13.04
Cephalic module								2.96	5.26	4.26	1.41	1.18
Length height index	5.77	4.76	4.72									
Breadth height index	3.52	7.05	8.13									
Fronto-parietal index	3.45	2.87	3.90	16.08	17.53	11.36						
Cephalo-facial index	2.49	8.10	6.44									
Zygo-facial index	5.57	9.21	11.96									
Facial index	4.42	5.95	6.09	9.44	5.13	5.21	0.14	0.50	1.46	0.24	0.44	0.15
Upper facial index	2.51	6.36	7.27	16.30	12.56	12.92						
Nasal index	2.45	0.06	1.22	8.66	8.39	9.37	0.22	2.40	2.94	3.51	5.79	5.26
Ear index				5.05	12.03	7.20	2.57	1.71	3.58	1.76	3.36	0.63
Average	3.66	5.22	5.56	9.50	9.50	7.02	2.27	4.91	6.77	3.39	3.87	3.71

TABLE 4 — (continued)

	BENI-SAKHR-MHARDEH	BENI-SAKHR-ALOUITE	BENI-SAKHR-TOTAL RIF	BENI-SAKHR-SENHAJA	BENI-SAKHR-GHOMARA	BENI-SAKHR-SHESHAWEN	BENI-SAKHR-RIF ARABS	BENI-SAKHR-SHLUH	BENI-SAKHR-KISH ARABS	BENI-SAKHR-IRAQ SOLDIERS	BENI-SAKHR-BAIJ BEDOUIN	RWALA-TOTAL RIF
Stature	9.22	6.30	10.10	7.07	3.48	1.58	7.39	4.40	8.22	16.40	6.96	20.74
Sitting height	7.11	5.93	5.35	4.68	0.07	3.81	4.75	0.24	3.49	4.06	0.77	13.16
Span	9.60	8.78	8.15	6.27	2.87	2.12	5.67	3.76				
Head length	8.39	18.30	8.16	5.03	0.48	4.93	6.52	5.29	2.42	4.10	1.95	10.26
Head breadth	9.93	13.93	8.22	5.20	7.64	8.74	5.15	2.96	1.88	2.56	3.00	8.37
Head height	6.67	2.66	12.86	10.98	6.79	6.26	6.75	5.40				
Minimum frontal diameter	9.53	13.05	5.37	3.02	1.15	5.36	0.94	2.14	17.20	22.69	10.41	7.89
Bizygomatic diameter	6.64	9.53	13.16	8.72	8.01	8.25	8.76	3.55	2.39	6.90	2.79	23.12
Bigonial diameter	17.27	7.49	6.42	0.02	0.51	0.50	0.72	4.80	0.66	7.09	1.05	1.95
Total facial height	1.08	3.12	6.31	2.98	1.53	3.13	4.24	6.28	0.53	1.57	3.47	12.82
Upper facial height	1.28	4.75	7.40	5.27	2.63	2.33	5.40	2.91	7.71	9.86	7.36	10.08
Nasal height	0.19	2.63	4.86	0.52	1.33	2.30	1.91	0.57	13.85	9.58	12.99	1.85
Nasal breadth	5.66	5.20	4.11	3.83	1.69	5.23	6.08	6.17	6.38	3.73	3.59	2.84
Ear height	5.88	2.82							3.46	3.30	3.06	
Ear breadth	2.56	1.20							8.61	10.84	10.11	
Relative sitting height	0.37	2.03	1.85	1.46	3.96	4.28	1.85	4.78	15.94	12.49	6.45	1.98
Cephalic index	15.87	25.93	0.27	0.65	6.44	3.86	0.92	1.49	1.14	5.70	3.33	0.09
Cephalic module	1.74	3.72										
Length height index			6.71	5.96	5.78	3.35	1.31	0.72				
Breadth height index			9.57	9.31	1.29	0.83	4.17	5.17				
Fronto-parietal index			0.13	0.27	4.60	3.45	2.94	4.59	22.42	13.59	12.66	
Cephalo-facial index			3.99	3.00	0.33	1.45	2.66	0.37				
Zygo-facial index			4.87	4.19	6.18	3.38	6.27	8.63				
Facial index	2.33	1.49	0.43	2.12	1.48	2.26	0.48	1.34	2.63	2.16	0.27	0.96
Upper facial index			1.62	0.66	1.74	1.70	1.16	1.04	10.16	6.42	8.59	
Nasal index	3.83	1.47	0.45	1.22	0.07	1.38	2.58	3.96	3.51	3.47	5.57	0.56
Ear index	1.92	3.39							5.34	11.52	7.34	
Average	6.05	6.84	5.64	4.02	3.05	3.46	3.85	3.50	6.90	7.90	5.59	7.78

TABLE 4 — *(continued)*

	RWALA-SENHAJA	RWALA-GHOMARA	RWALA-SHESHAWEN	RWALA-RIF ARABS	RWALA-SHLUH	RWALA-KISH ARABS	RWALA-IRAQ SOLDIERS	RWALA-BAIJ BEDOUIN	AKEYDAT-TOTAL RIF	AKEYDAT-SENHAJA	AKEYDAT-GHOMARA
Stature	13.01	6.55	3.36	11.80	9.67	16.35	30.14	10.15	0.27	2.79	5.60
Sitting height	10.54	2.26	8.41	8.81	3.72	24.03	9.17	1.67	2.19	2.39	6.82
Span									0.87	0.67	3.33
Head length	3.68	2.20	3.76	5.96	4.50	9.16	11.32	0.19	7.22	3.06	1.71
Head breadth	3.68	6.74	7.92	3.68	0.47	6.71	0.03	4.97	1.04	3.36	1.16
Head height									17.22	14.56	9.13
Minium frontal diameter	4.54	1.92	3.27	1.72	1.85	22.68	28.85	11.80	9.34	13.09	11.84
Bizygomatic diameter	14.38	11.63	10.70	13.30	7.77	1.21	11.95	2.04	3.53	0.39	0.90
Bigonial diameter	6.72	4.02	2.42	6.15	14.91	8.15	3.33	4.94	4.75	10.96	7.68
Total facial height	6.75	3.55	4.83	7.24	1.27	1.50	3.93	2.89	1.70	2.41	3.03
Upper facial height	5.33	1.12	0.93	4.97	1.29	9.09	13.41	7.40	1.85	0.54	2.76
Nasal height	7.66	4.36	1.65	3.42	8.37	13.81	6.59	10.96	0.22	3.83	2.28
Nasal breadth	2.44	4.44	1.86	2.11	1.71	2.05	2.87	0.38	8.94	8.02	8.75
Ear height						7.45	3.38	4.53			
Ear breadth						12.44	15.45	11.10			
Relative sitting height	1.32	4.78	5.39	1.77	6.02	21.73	15.40	6.67	3.60	3.13	0.02
Cephalic index	0.72	8.13	4.43	1.55	2.93	1.59	8.43	3.96	7.38	5.58	2.81
Facial index	3.40	4.41	1.68	0.80	2.30	3.13	3.46	0.45	1.14	3.07	3.89
Nasal index	2.63	1.89	2.56	4.20	8.28	7.31	6.66	7.67	5.09	1.82	3.09
Ear index						6.38	17.14	8.04			
Average	5.79	4.53	4.21	5.17	5.00	9.71	10.30	5.10	4.49	4.69	4.40

TABLE 4 — (*continued*)

	AKEYDAT-SHESHAWEN	AKEYDAT-RIF ARABS	AKEYDAT-SHLUH	AKEYDAT-KISH ARABS	AKEYDAT-IRAQ SOLDIERS	AKEYDAT-BALJ BEDOUIN	MAUALY-TOTAL RIF	MAUALY-SENHAJA	MAUALY-GHOMARA	MAUALY-SHESHAWEN	MAUALY-RIF ARABS
Stature	6.34	0.88	6.50	1.78	8.81	0.30	4.19	7.13	9.26	9.25	3.98
Sitting height	2.99	1.23	8.10	12.55	2.92	5.34	6.90	6.40	10.46	6.67	4.01
Span	3.02	0.34	2.39				4.90	5.76	7.47	6.16	4.31
Head length	3.63	5.14	3.54	6.24	8.03	0.03	10.35	5.31	0.30	4.83	7.16
Head breadth	4.06	2.20	6.48	12.42	6.51	8.15	4.49	6.45	0.69	2.86	4.55
Head height	7.47	8.91	8.36				13.21	10.11	4.62	4.76	4.64
Minimum frontal diameter	5.91	12.44	19.78	1.88	8.71	0.57	17.35	17.47	14.69	7.46	15.50
Bizygomatic diameter	2.44	1.11	5.48	11.13	1.61	8.06	0.37	3.13	1.79	0.49	1.83
Bigonial diameter	5.04	9.74	17.75	12.22	2.76	7.98	5.78	12.44	8.28	5.24	10.59
Total facial height	0.21	0.08	7.22	7.31	4.72	8.32	0.14	4.17	4.33	1.08	1.12
Upper facial height	2.21	6.12	3.31	2.85	5.51	3.32	1.92	4.10	5.57	4.41	1.94
Nasal height	0.64	1.69	3.95	9.66	5.49	10.12	2.92	8.05	4.78	2.22	4.05
Nasal breadth	1.75	3.16	4.85	4.80	8.50	2.55	10.37	9.49	10.07	3.11	4.91
Ear height				0.65	7.03	1.16					
Ear breadth				11.03	13.76	11.16					
Relative sitting height	8.11	2.30	0.16	12.78	9.29	4.12	4.30	3.50	0.21	8.59	2.50
Cephalic index	0.40	6.48	7.36	5.28	1.13	6.96	14.09	10.48	0.07	2.07	10.47
Facial index	1.94	1.05	2.06	1.73	2.91	0.74	3.18	5.20	5.81	2.91	2.31
Nasal index	0.09	0.48	2.14	9.56	9.11	9.67	7.44	2.76	3.94	0.24	0.05
Ear index				11.80	21.06	11.71					
Average	3.31	3.73	6.44	7.54	7.10	5.57	6.58	7.17	5.43	4.26	4.94

TABLE 4 — (*continued*)

	MAUALY-SHLUH	MAUALY-KISH ARABS	MAUALY-IRAQ SOLDIERS	MAUALY-BAIJ BEDOUIN	HIDJANEH-TOTAL RIF	HIDJANEH-SENHAJA	HIDJANEH-GHOMARA	HIDJANEH-SHESHAWEN	HIDJANEH-RIF ARABS	HIDJANEH-SHLUH	HIDJANEH-KISH ARABS
Stature	11.75	6.32	6.32	2.82	14.20	7.55	1.73	0.51	7.23	3.12	10.00
Sitting height	13.97	19.45	6.82	7.93	6.08	5.58	9.97	5.89	3.18	13.91	19.86
Span	10.44				6.61	3.46	0.68	0.88	2.90	0.67	
Head length	6.01	4.67	6.79	1.46	32.35	21.40	10.15	12.50	20.38	24.05	11.73
Head breadth	10.34	17.41	10.08	9.72	13.00	7.16	9.19	11.02	6.43	4.24	2.95
Head height	2.44				19.44	14.64	7.33	6.08	7.12	6.30	
Minimum frontal diameter	25.69	0.54	7.41	0.86	12.36	6.83	2.95	3.89	2.78	1.13	31.05
Bizygomatic diameter	11.10	17.57	5.72	10.52	21.35	13.00	10.58	9.92	12.12	6.12	2.59
Bigonial diameter	20.55	14.04	3.28	8.40	6.92	3.58	1.76	0.95	3.61	12.10	4.91
Total facial height	9.43	9.66	6.67	9.65	13.41	6.40	3.00	4.44	6.88	0.31	0.53
Upper facial height	8.07	0.08	2.70	1.23	13.72	7.84	2.74	2.19	6.68	3.80	11.55
Nasal height	8.63	11.10	4.95	10.03	21.95	10.04	8.04	7.33	8.83	11.18	34.68
Nasal breadth	6.70	6.70	9.96	3.68	7.38	5.93	1.77	6.05	8.57	10.48	11.28
Ear height		0.82	9.50	0.34							7.75
Ear breadth		15.88	18.49	13.28							13.78
Relative sitting height	0.20	14.73	10.23	4.24	22.43	15.18	15.59	3.73	13.76	23.11	39.34
Cephalic index	14.45	10.57	2.82	9.24	15.59	11.65	0.88	2.74	11.42	15.70	11.83
Facial index	4.20	1.10	5.26	1.65	1.18	3.63	4.58	1.80	0.93	2.51	3.03
Nasal index	1.88	12.64	11.73	10.88	9.23	3.75	9.50	0.70	0.62	1.00	14.47
Ear index		16.35	25.92	14.07							7.57
Average	9.76	9.98	8.59	6.67	13.95	8.68	5.91	4.74	7.26	8.22	13.27

TABLE 4 — (continued)

	HIDJANEH-IRAQ SOLDIERS	HIDJANEH-BAIJ BEDOUIN	HAFAR-TOTAL RIF	HAFAR-SENHAJA	HAFAR-GHOMARA	HAFAR-SHESHAWEN	HAFAR-RIF ARABS	HAFAR-SHLUH	HAFAR-KISH ARABS	HAFAR-IRAQ SOLDIERS	HAFAR-BAIJ BEDOUIN
Stature	24.69	6.36	1.17	1.59	4.36	5.29	0.06	4.77	0.64	8.53	0.36
Sitting height	6.03	7.39	4.68	5.00	8.56	5.14	3.28	10.03	14.10	5.14	7.00
Span			0.00	1.38	3.86	3.46	0.95	4.73			
Head length	8.00	11.57	9.69	5.88	0.98	5.47	7.52	6.42	2.05	3.89	2.51
Head breadth	3.53	3.34	6.74	3.57	6.43	7.82	3.70	1.07	4.26	0.71	4.22
Head height			11.17	9.42	4.49	4.78	4.54	2.42			
Minimum frontal diameter	37.26	13.18	2.12	3.99	4.61	1.13	4.99	10.02	11.17	17.37	6.17
Bizygomatic diameter	10.54	2.72	7.23	3.67	3.68	4.70	4.12	2.00	7.85	1.72	6.07
Bigonial diameter	7.31	3.14	0.29	6.87	4.53	2.87	6.37	13.58	8.02	1.73	5.35
Total facial height	3.28	3.63	3.63	0.16	1.23	1.06	1.73	4.43	4.42	2.26	6.43
Upper facial height	16.52	8.90	7.40	4.26	0.97	0.85	4.38	1.01	7.50	10.60	6.72
Nasal height	24.40	20.31	8.13	3.63	3.93	4.44	4.51	3.77	16.75	12.47	15.05
Nasal breadth	5.91	3.79	2.83	2.75	4.20	0.46	0.09	0.52	0.39	2.95	0.56
Ear height	3.38	4.60							3.28	10.71	1.27
Ear breadth	16.77	11.31							10.85	13.60	11.06
Relative sitting height	29.05	13.03	10.50	8.73	10.43	1.08	8.52	12.92	24.76	20.06	10.59
Cephalic index	3.91	9.81	4.27	3.14	4.25	2.32	4.42	5.96	2.74	3.03	5.70
Facial index	3.69	0.55	1.10	2.89	3.93	1.75	1.00	2.06	1.88	2.93	0.69
Nasal index	13.33	11.68	9.86	6.50	7.09	3.09	3.75	3.31	13.43	12.99	12.75
Ear index	19.02	8.62							12.86	20.97	12.85
Average	13.14	8.00	5.34	4.32	4.56	3.28	3.76	5.24	8.16	8.43	6.41

TABLE 4 — *(continued)*

	HAMA-TOTAL RIF	HAMA-SENHAJA	HAMA-GHOMARA	HAMA-SHESHAWEN	HAMA-RIF ARABS	HAMA-SHLUH	HAMA-KISH ARABS	HAMA-IRAQ SOLDIERS	HAMA-BAIJ BEDOUIN	MHARDEH-TOTAL RIF	MHARDEH-SENHAJA
Stature	11.54	6.93	2.20	0.09	7.04	3.33	8.67	20.09	6.39	2.19	2.87
Sitting height	7.17	5.67	1.12	0.64	5.21	1.03	6.65	4.63	0.88	3.90	3.89
Span	3.69	1.47	1.91	1.83	1.41	2.38				3.85	4.86
Head length	31.43	20.35	9.28	11.88	19.48	23.00	10.38	6.68	10.75	26.27	18.21
Head breadth	8.59	3.41	6.60	7.80	3.44	0.04	7.85	0.47	5.18	4.11	6.08
Head height	12.40	9.78	4.75	4.88	4.77	2.69				7.59	5.33
Minimum frontal diameter	9.01	10.21	9.41	4.13	10.00	17.30	6.01	13.02	2.83	7.59	9.00
Bizygomatic diameter	10.11	5.50	5.08	5.82	5.75	0.91	7.44	3.29	5.61	5.23	1.59
Bigonial diameter	1.43	8.32	5.60	3.60	7.54	15.16	9.54	0.23	6.24	1.58	8.68
Total facial height	6.52	1.37	0.26	1.93	3.18	4.00	4.56	1.28	6.15	7.53	2.57
Upper facial height	9.21	5.15	1.27	1.07	4.94	1.48	8.70	12.51	7.31	9.44	5.73
Nasal height	9.18	1.94	2.55	3.31	3.27	2.12	21.87	14.65	15.66	7.26	0.95
Nasal breadth	5.44	4.88	6.24	0.17	0.44	1.52	1.35	5.30	0.96	3.22	2.98
Ear height							2.68	6.71	2.26		
Ear breadth							13.38	20.75	11.92		
Relative sitting height	2.40	1.73	4.47	4.69	2.11	5.79	19.29	14.55	6.79	2.50	1.97
Cephalic index	11.80	10.56	3.56	4.85	11.01	12.73	10.46	5.84	10.60	23.78	19.75
Facial index	0.87	3.10	4.16	1.63	0.77	2.08	2.80	3.15	0.45	3.59	0.94
Nasal index	11.65	6.38	6.87	2.31	2.89	2.27	16.16	15.16	13.25	8.05	4.01
Ear index							10.14	19.72	10.59		
Average	8.97	6.28	4.43	3.57	5.49	5.75	9.33	9.34	6.88	7.51	5.83

TABLE 4 — (*continued*)

	MHARDEH-GHOMARA	MHARDEH-SHESHAWEN	MHARDEH-RIF ARABS	MHARDEH-SHLUH	MHARDEH-KISH ARABS	MHARDEH-IRAQ SOLDIERS	MHARDEH-BAIJ BEDOUIN	ALOUITE-TOTAL RIF	ALOUITE-SENHAJA	ALOUITE-GHOMARA	ALOUITE-SHESHAWEN
Stature	6.21	6.69	0.21	8.74	1.40	15.66	0.35	7.19	1.71	2.69	3.98
Sitting height	8.42	4.41	2.20	10.84	16.05	4.44	6.48	1.56	1.86	7.24	2.64
Span	6.74	5.71	3.74	8.93				1.63	3.17	5.57	4.00
Head length	9.19	11.86	18.16	19.90	9.42	6.50	10.60	46.74	33.95	2.53	19.24
Head breadth	0.67	2.82	4.37	9.62	16.15	9.47	9.57	10.18	11.02	3.81	0.79
Head height	1.17	3.05	1.64	1.84				17.24	12.82	6.05	5.43
Minimum frontal diameter	8.14	2.95	8.77	17.53	10.45	18.19	4.59	13.23	13.77	11.67	5.20
Bizygomatic diameter	1.91	3.30	2.24	4.71	10.79	0.55	7.59	4.36	0.30	0.48	2.31
Bigonial diameter	5.75	3.66	7.75	15.85	9.98	0.16	6.36	2.29	10.40	6.36	3.86
Total facial height	0.70	2.68	4.08	2.50	2.44	0.04	5.18	5.81	0.13	1.43	1.24
Upper facial height	1.91	1.59	5.45	2.31	9.06	12.57	7.73	5.31	1.27	1.83	1.37
Nasal height	1.79	2.73	2.49	1.05	19.12	12.82	21.26	4.17	3.16	0.99	0.71
Nasal breadth	4.67	1.01	0.78	0.09	0.28	3.29	0.22	1.89	1.69	3.84	2.19
Ear height					3.86	11.76	1.49				
Ear breadth					9.85	12.96	10.11				
Relative sitting height	4.56	4.09	2.32	5.54	17.38	13.58	6.81	0.60	4.39	6.88	3.27
Cephalic index	8.23	8.87	18.62	23.43	20.34	12.91	14.86	38.27	32.44	18.23	17.40
Facial index	0.91	1.10	2.46	2.04	6.54	0.89	2.12	2.03	1.09	2.69	0.18
Nasal index	4.94	1.13	1.21	0.02	12.51	11.85	11.40	4.44	0.32	2.04	1.07
Ear index					12.42	21.85	12.08				
Average	4.47	3.98	5.08	7.94	10.44	9.42	7.71	9.82	7.85	4.96	4.40

TABLE 4 — (*continued*)

	ALOUITE-RIF ARABS	ALOUITE-SHLUH	ALOUITE-KISH ARABS	ALOUITE-IRAQ SOLDIERS	ALOUITE-BAIJ BEDOUIN	TOTAL RIF-SENHAJA	TOTAL RIF-GHOMARA	TOTAL RIF-SHESHAWEN	TOTAL RIF-RIF ARABS	TOTAL RIF-SHLUH	SENHAJA-GHOMARA	SENHAJA-SHESHAWEN
Stature	2.94	2.74	3.57	18.58	2.88	4.48	7.26	7.51	1.33	10.26	3.78	4.84
Sitting height	0.45	9.95	16.02	2.56	5.37	0.65	6.69	1.62	0.52	9.87	5.66	0.96
Span	2.12	8.37				2.00	4.84	3.98	1.20	7.48	3.07	2.75
Head length	30.93	37.43	26.35	21.87	20.47	4.56	7.84	0.05	0.46	4.69	4.38	1.93
Head breadth	8.16	15.55	23.34	14.95	11.88	3.31	2.14	5.16	1.74	7.77	3.96	6.02
Head height	5.94	4.43				1.38	3.93	0.33	3.25	10.17	2.77	0.81
Minimum frontal diameter	12.44	22.46	4.76	12.83	1.82	3.15	3.90	0.10	4.32	13.04	1.63	1.07
Bizygomatic diameter	0.73	9.17	16.46	3.16	9.30	4.20	2.26	0.33	2.44	14.69	0.66	2.38
Bigonial diameter	8.70	19.72	12.18	0.00	6.81	9.20	5.33	3.15	7.71	19.20	0.58	0.53
Total facial height	2.22	6.34	6.53	3.13	7.47	5.53	5.02	1.23	1.40	16.15	1.97	1.29
Upper facial height	2.10	3.15	5.47	9.57	4.94	3.11	5.08	3.68	0.85	8.32	2.36	1.98
Nasal height	0.22	3.45	19.42	11.27	13.47	6.91	3.31	0.94	2.51	7.51	1.10	2.24
Nasal breadth	2.59	2.35	2.72	2.06	0.66	0.12	2.74	3.06	3.96	4.25	2.44	2.94
Ear height			1.58	8.82	1.61							
Ear breadth			20.83	22.88	14.59							
Relative sitting height	4.46	9.40	2.53	18.27	8.13	0.20	3.31	6.62	0.50	4.67	3.67	6.12
Cephalic index	29.65	36.63	33.52	25.11	22.08	0.71	8.34	4.50	1.68	3.27	7.10	3.92
Length height index						0.44	1.12	2.53	5.45	9.40	1.18	2.75
Breadth height index						1.50	5.09	3.63	2.20	3.86	5.81	4.20
Fronto-parietal index						0.12	5.44	3.70	3.66	6.88	4.77	3.45
Cephalo-facial index						1.05	4.54	4.62	1.00	6.41	3.18	3.55
Zygo-facial index						0.19	3.15	0.69	3.23	6.21	2.87	7.34
Facial index	1.09	0.20	5.78	1.15	1.00	2.96	4.13	1.22	0.18	1.70	1.80	0.47
Upper facial index						1.45	4.37	3.24	0.19	0.95	3.00	2.49
Nasal index	1.96	4.75	10.23	9.45	9.39	3.21	0.50	3.07	7.00	9.34	1.72	1.19
Ear index			18.55	28.80	14.74							
Average	6.86	11.53	12.76	11.91	8.70	2.63	4.36	2.82	2.47	8.05	3.02	2.84

TABLE 4 — (*continued*)

	SENHAJA-RIF ARABS	SENHAJA-SHLUH	GHOMARA-SHESHAWEN	GHOMARA-RIF ARABS	GHOMARA-SHLUH	SHESHAWEN-RIF ARABS	SHESHAWEN-SHLUH	RIF ARABS-SHLUH	TOTAL RIF-KISH ARABS	TOTAL RIF-IRAQ SOLDIERS	TOTAL RIF-BAIJ BEDOUIN	SENHAJA-KISH ARABS
Stature	1.62	4.47	1.62	4.43	0.46	5.40	2.22	4.98	3.22	13.49	0.55	1.49
Sitting height	0.87	6.96	4.53	7.27	0.39	1.59	5.50	6.36	16.59	1.51	4.81	13.26
Span	0.24	4.17	0.30	2.89	0.25	2.66	0.54	3.37				
Head length	2.75	0.35	4.59	6.12	4.84	0.19	1.80	2.63	19.93	21.18	5.46	11.37
Head breadth	0.70	3.31	2.77	2.96	6.44	5.28	7.75	3.32	16.77	7.60	8.21	9.87
Head height	2.22	7.49	2.16	0.29	2.81	1.94	3.83	2.98				
Minimum frontal diameter	1.91	7.79	1.91	0.24	3.61	2.09	3.76	3.49	21.71	29.38	8.41	20.31
Bizygomatic diameter	0.90	8.00	1.68	0.14	6.52	1.67	6.80	7.54	21.86	7.46	11.19	14.44
Bigonial diameter	0.89	6.68	0.14	1.21	5.14	1.00	3.43	4.04	11.08	1.96	5.96	0.78
Total facial height	2.25	5.93	2.12	2.96	2.76	0.26	4.25	6.60	13.15	8.69	10.68	6.02
Upper facial height	1.16	4.00	0.05	3.06	2.33	2.53	0.24	4.07	1.76	5.67	2.51	3.92
Nasal height	1.82	0.04	1.25	0.60	1.14	0.76	2.26	1.89	17.25	8.76	12.02	19.77
Nasal breadth	3.71	3.68	4.28	5.17	5.24	0.44	1.03	0.79	4.62	0.43	1.33	4.02
Ear height												
Ear breadth												
Relative sitting height	0.57	4.00	7.84	2.31	0.07	5.90	8.70	2.77	22.79	15.40	6.09	17.36
Cephalic index	1.88	3.05	1.80	7.94	9.45	4.87	5.77	0.48	1.65	8.82	4.03	0.66
Length height index	4.71	7.61	1.00	4.81	6.30	2.50	3.23	0.91				
Breadth height index	3.00	4.48	0.11	2.35	2.44	1.89	1.86	3.71				
Fronto-parietal index	3.11	5.05	0.24	1.79	1.32	1.51	1.11	0.85	34.21	33.33	13.99	26.98
Cephalo-facial index	0.14	3.87	1.81	2.74		3.62	1.93	3.15				
Zygo-facial index	2.93	5.31	1.17	0.03	1.14	1.12	2.02	1.21				
Facial index	1.84	1.21	1.73	1.12	2.77	0.92	0.29	0.93	4.49	3.06	0.04	6.33
Upper facial index	0.74	0.52	0.35	3.05	3.61	2.75	2.83	0.39		8.70	9.25	13.85
Nasal index	2.03	4.40	2.16	3.18	5.27	0.24	1.16	1.26	7.48	6.72	7.59	7.73
Average	1.83	4.45	1.98	2.68	3.38	2.22	3.14	2.94	13.66	10.71	6.60	10.48

TABLE 4 — *(continued)*

	SENHAJA-IRAQ SOLDIERS	SENHAJA-BAIJ BEDOUIN	GHOMARA-KISH ARABS	GHOMARA-IRAQ SOLDIERS	GHOMARA-BAIJ BEDOUIN	SHESHAWEN-KISH ARABS	SHESHAWEN-IRAQ SOLDIERS	SHESHAWEN-BAIJ BEDOUIN	RIF ARABS-KISH ARABS	RIF ARABS-IRAQ SOLDIERS	RIF ARABS-BAIJ BEDOUIN
Stature	14.97	1.81	5.07	15.09	4.31	5.84	13.67	5.23	0.60	9.23	0.43
Sitting height	0.79	4.28	4.09	4.88	0.02	10.71	0.21	3.53	10.76	1.45	4.43
Head length	13.23	2.42	3.13	4.83	1.51	7.52	8.69	3.31	12.19	13.78	4.28
Head breadth	3.44	6.51	11.08	6.51	8.36	10.79	7.80	9.57	8.54	3.51	6.55
Minimum frontal diameter	27.20	9.48	15.62	21.30	9.49	7.34	11.09	5.53	16.76	22.46	9.84
Bizygomatic diameter	2.53	8.90	11.98	2.63	8.64	11.10	3.91	9.03	13.52	3.12	9.08
Bigonial diameter	9.44	1.19	1.23	6.08	1.44	0.95	3.79	0.96	0.21	8.21	0.48
Total facial height	2.85	7.26	2.70	0.71	5.19	4.22	2.75	6.14	6.58	4.33	7.94
Upper facial height	7.30	4.00	5.43	7.86	5.37	4.32	6.13	4.60	1.85	4.06	2.57
Nasal height	12.75	14.57	12.80	8.36	12.13	8.10	4.98	9.38	12.04	7.65	11.64
Nasal breadth	0.26	1.34	5.60	2.28	2.59	0.91	3.14	0.91	0.64	3.95	0.68
Relative sitting height	12.91	6.26	11.08	8.21	3.86	18.30	15.38	9.09	11.58	11.14	5.39
Cephalic index	6.77	4.12	6.90	1.94	8.16	3.62	0.32	6.12	2.52	7.48	2.82
Fronto-parietal index	27.63	13.52	25.00	26.05	15.33	16.44	17.63	13.00	25.23	26.18	14.58
Facial index	0.05	1.59	6.68	1.75	2.68	3.65	0.51	0.92	3.20	1.88	0.15
Upper facial index	8.39	9.47	14.13	9.78	10.73	10.15	7.14	9.16	9.70	5.57	7.99
Nasal index	7.73	8.63	4.56	4.43	6.47	5.39	5.33	5.35	8.33	8.08	9.18
Average	9.31	6.20	8.65	7.81	6.25	7.61	6.62	5.99	8.49	8.35	5.77

TABLE 4 — (*continued*)

	SHLUH-KISH ARABS	SHLUH-IRAQ SOLDIERS	SHLUH-BAIJ BEDOUIN	KISH ARABS-IRAQ SOLDIERS	KISH ARABS-BAIJ BEDOUIN	IRAQ SOLDIERS-BAIJ BEDOUIN
Stature	6.61	21.00	4.58	15.01	0.99	6.95
Sitting height	36.39	6.16	3.12	11.65	3.02	3.74
Head length	13.03	14.81	2.75	2.88	4.88	6.47
Head breadth	7.21	0.41	5.10	6.24	2.17	4.84
Minimum frontal diameter	31.29	37.15	13.61	9.47	0.61	5.29
Bizygomatic diameter	8.20	5.06	5.42	12.19	1.42	7.66
Bigonial diameter	6.01	17.41	2.39	10.92	0.70	6.61
Total facial height	0.19	2.88	3.77	2.85	3.95	5.46
Upper facial height	7.78	11.85	6.57	2.72	1.27	0.50
Nasal height	21.54	13.62	14.87	5.48	4.33	7.13
Nasal breadth	0.23	4.10	0.28	4.49	0.37	1.47
Ear height				9.79	0.83	6.18
Ear breadth				4.53	4.81	2.18
Relative sitting height	15.71	10.57	4.21	2.05	2.21	1.12
Cephalic index	4.04	10.00	2.74	6.54	4.50	7.58
Cephalo-facial index	35.49	37.46	16.04	3.27	1.55	0.02
Facial index	5.38	1.29	0.88	6.39	2.34	1.62
Upper facial index	14.54	8.58	9.41	5.79	1.69	4.83
Nasal index	14.19	13.25	11.93	0.07	3.90	3.75
Ear index				11.56	4.19	3.29
Average	11.63	12.68	6.33	6.69	2.49	4.33

Total Rif 6.97. Likewise the Rwala-Riffian significance ratios are all high, ranging from Rwala-Sheshawen 4.53 to Rwala-Total Rif 7.78.

The statistical comparison shows that the Beni Sakhr are remarkably similar to most of the Riffian groups, but that the Howeitat and Rwala are somewhat dissimilar. Inasmuch as Beni Sakhr and Ghomara have the lowest significance ratio we will use these groups to compare their characteristics. The skin color of Ghomara is somewhat lighter than that of the Beni Sakhr which falls in the darker shades. Both have head hair that is nearly always black or dark brown. The color of the beard for Ghomara is frequently of a lighter hue than that of the Beni Sakhr. The Ghomara eyes in general are also lighter in color than those of Beni Sakhr as evidenced by the high percentages of brown eyes mixed with gray, green and blue. The Ghomara have more facial hair than the Beni Sakhr, but body hair among Beni Sakhr and some Riffians, such as the Rif Arabs and Shluh, shows little development. Both Beni Sakhr and Ghomara have nasal bridge heights far above the European average; the same is true for the nasal bridge breadths. Convex noses occur much more frequently among the Ghomora than among the Beni Sakhr. Those measurements in which Beni Sakhr and Ghomara are significantly different are as follows: the Beni Sakhr men are shorter than those of Ghomara, 163 and 165, they have narrower heads, 142 and 147, and lower head heights, 124 and 127, narrower bizygomatic diameters 131 and 135, lower cephalic indices, 74.9 and 77.3, and lower cephalic modules, 152.0 and 154.8.

Next follows a comparison between the tall-statured Bedouin, Akeydat and Maualy, with the Riffian groups. The Akeydat-Sheshawen, ratio 3.31, and Akeydat-Rif Arabs, ratio 3.73, are the lowest, the rest range from Akeydat-Ghomara 4.40 to Akeydat-Shluh 6.44. The Maualy-Riffian significance ratios are all high and range from Maualy-Sheshawen 4.26 to Maualy-Shluh 9.76. Both Akeydat and Maualy are more like the intermediate Riffian groups, but tend more toward the Total Rif than toward Shluh. A morphological comparison

between Akeydat and Ghomara follows: those characters in which they are significantly different are: the Akeydat have taller statures than Ghomara, 168 and 165, greater spans, 175 and 172, higher sitting heights, 86 and 83, but lower head heights, 123 and 127, broader bigonial diameters, 108 and 103, longer faces, 123 and 121, higher facial indices, 91.9 and 89.7, broader noses, 36 and 34, and higher nasal indices 65.9 and 63.8.

This comparative study shows clearly that the Rwala, Beni Sakhr and Howeitat are actually smaller men than the Riffians, whereas the Akeydat and Maualy are larger in nearly every measurement than the Riffians. The Riffians form an intermediate group with the Bedouin at the opposite poles.

Significance ratios are included in table 4 of this study between the Syrian desert border groups and the Riffians. In general it can be stated most of these mean inter-group significance ratios are of a high order. Hafar is most like the Riffian groups.

A survey of the Beni Sakhr-Iraq male mean significance ratios (table 4) shows in a striking manner the dissimilarity of these groups, for all these ratios are of a high order; Beni Sakhr-Ba'ij Bedouin 5.59, Beni Sakhr-Kish Arabs 6.90, and Beni Sakhr-Iraq Soldiers 7.90. The Howeitat-Iraq ratios are still higher and the same is true for Rwala-Iraq. The Kish Arabs are intermediate between the Iraq Soldiers and the Ba'ij Bedouin, hence will be used to compare with the Beni Sakhr. The characters and indices in which Beni Sakhr and Kish Arabs are significantly different are: the Beni Sakhr men are shorter than those of Kish, 163 and 168, but have higher sitting heights, 83 and 82, have narrower minimum frontal diameters, 104 and 111, have lower upper facial heights, 69 and 73, much shorter noses, 53 and 58, narrower noses 33 and 35, shorter ears, 61 and 62, narrower ears, 32 and 35, higher sitting height indices, 51.2 and 49.0, lower fronto-parietal indices 72.9 and 78.6, higher nasal indices, 63.9 and 61.1, and lower ear indices, 53.8 and 56.9. One can conclude

that the Beni Sakhr, and also the Howeitat and Rwala are not only much shorter than the Kish Arabs but they are smaller in nearly every measurement compared.

The Kish Arab stature is 168, the Ba'ij Bedouin 168 and the Iraq Soldiers 173. The statures of the first two groups are like that of Akeydat, 168, but lower than Maualy, 170. It has been shown above that the Iraq males differ from the short statured Bedouin. We shall next try to determine if they are more similar to the tall-statured Bedouin. The mean significance ratios of these groups are: Akeydat-Ba'ij Bedouin 5.57, Akeydat-Iraq Soldiers 7.10, and Akeydat-Kish Arabs 7.54. The Maualy-Iraq ratios are still higher. Comparing those characters in which the Akeydat and the Kish Arabs are significantly different we find the Akeydat have higher sitting heights, 86 and 82, longer heads, 191 and 188, broader heads, 146 and 142, broader bizygomatics, 135 and 129, greater bigonials, 108 and 102, longer faces, 123 and 120, but shorter noses, 58 and 55. The Akeydat have broader noses, 36 and 35, narrower ears, 33 and 35, higher relative sitting heights, 50.5 and 49.0, higher cephalic indices, 76.4 and 75.3, higher nasal indices, 65.9 and 61.1, but lower ear indices, 52.8 and 56.9.

The Kish Arabs and the Ba'ij Bedouin are very similar and have a low mean significance ratio, 2.49, but both differ markedly from the Iraq Soldiers, Kish-Soldiers, 6.69, Ba'ij-Soldiers 4.33. We can conclude that the Kish Arabs and the Ba'ij Bedouin are smaller than the Akeydat in nearly every measurement. Likewise the Maualy are larger.

When the Syrian desert border groups are compared to the Iraq groups the mean significance ratios are all of a very high order, lowest Hafar-Ba'ij 6.41, highest Hidjaneh-Kish Arabs 13.27.

The Riffian-Iraq mean significance ratios are also all of a high order, lowest Sheshawen-Ba'ij Bedouin 5.99, highest Total Rif-Kish Arabs 13.66. In every instance each of the Riffian groups is more like the Ba'ij Bedouin than like the Kish Arabs or the Iraq Soldiers.

SUMMARY

The results of fifteen measurements, fifteen indices and numerous observations on two Bedouin tribes, the Beni Sakhr and the Howeitat, supports the idea that there are two varieties of the Mediterranean race living in the Transjordan and Syrian deserts. These two tribes are very similar to the Rwala Bedouin but all three differ markedly from the Akeydat and the Maualy Bedouin. These two groups differ fundamentally in size, for the Akeydat and Maualy are tall men who are larger in practically every character measured, whereas the Rwala, Beni Sakhr and the Howeitat are short and at the same time small men. We believe these short-statured Bedouin belong to the Mediterranean race proper, as defined by Coon ('39). These short Mediterraneans were spreading from the Near East across north Africa as early as 4000 B.C., furthermore it is suggested that the tall-statured Bedouin are related to the early Megalith builders who were migrating from the Near East around 2000 B.C. Comparative studies suggest there is a marked similarity between some of these Bedouin tribes and some of the Riffians. In fact from a statistical standpoint the Akeydat Bedouin in the Syrian desert are closer morphologically to the Sheshawen and the Rif Arabs of Morocco than they are to their neighbors the Rwala Bedouin.

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Beni Sakhr males

Howeitat males

Akeydat males

Maualy males

THE BODY SIZE OF SOUTH AFRICAN NEGROID SCHOOLBOYS COMPARED WITH NORTH AMERICAN SCHOOLBOYS OF WHITE, MONGOLOID, AND NEGROID STOCKS

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Le Riche ('44) has recently reported "A Somatometric Study of South African Bantu School Children." Included in this study are means for stature, weight (nude), arm girth ("relaxed") and hip width (bi-iliocristal diameter) based upon measurement of nearly 3000 schoolboys between the ages of 6 and 16 years. It is the purpose of the present paper to align these means with comparable means on several groups of schoolboys studied in North America.

Comparable means for all four measurements are available on North American schoolboys of White (Northwest European and Italian), Mongoloid (Chinese), and Negroid stocks. The Chinese materials are afforded partly by Wong and Lee ('36) — stature, weight, arm girth — and partly by Preston ('36) — hip width. The materials for the other groups are accessible from previously unpublished studies by Meredith ('45), Matheny and Meredith ('40) and McLendon ('37).

Le Riche's subjects were Bantu-speaking Negro schoolboys residing in nine areas of the Union of South Africa — three urban (Pretoria, Pietermaritzburg, Bloemfontein) and six rural (Bochem, Letaba, Nqutu, Witzieshoek, Qumbu, Kentani). Since "powerful economic and social influences keep Bantu children away from schools," the subjects were

considered to represent "probably the best of the Bantu child population" ('44, pp. 8, 45).[1] With reference to tribal selection, it was stated: "In Pietermaritzburg and Nqutu the children are Zulus. Those in Bochem and Pretoria are mainly Transvaal Sesuto, while Qumbu and Kentani are both in the Transkei (Xosas, Fingoes and Pondos)" ('44, p. 41). Although there was no compulsory birth registration in native areas, an effort was made to obtain for each subject "as accurate as possible a statement of age from teachers and others" ('44, p. 9).

Meredith's subjects were White boys of Northwest European ancestry, living in or near Iowa City, Iowa, and enrolled at the University of Iowa experimental schools during the decade 1930–39. They were drawn predominantly from the professional and managerial classes. The subjects studied by Matheny and Meredith were White boys of Italian ancestry in attendance 1938–39 at public schools within a radius of 50 miles around Hibbing, Minnesota. Their fathers were almost all unskilled or semiskilled workmen (mean family income approximated $1,100).

The Mongoloid subjects were residents of "Chinatown," San Francisco. They were boys of Cantonese ancestry examined through "language and church schools" by Preston in 1931, and through "public, parochial and private schools" by Wong and Lee in 1935. Roughly half represented the lower occupational categories (unskilled or semiskilled) and half the middle categories (skilled, commercial, or small business).

McLendon's subjects were Negro boys in attendance 1936–37 at "North East Junior High School and Sumner High School in Kansas City, Kansas" ('37, p. 2). They were accepted without reference to socio-economic level or degree of White admixture.

[1] Le Riche made the following overall appraisal: "As far as one can see, the environment of the Bantu children is very bad, their food is inadequate in amount and quality, and as a race their morbidity rates are high" ('44, p. 25).

For all of the foregoing studies, the tabulation which follows shows the number of schoolboys measured at each year of age:

MIDPOINT OF AGE GROUP	LE RICHE	MEREDITH	MATHENY AND MEREDITH	WONG AND LEE	PRESTON	MC LENDON
(yrs.)						
6.5	76	145	45	110	13	
7.5	141	124	51	123	10	
8.5	225	121	55	114	16	
9.5	231	115	65	127	29	
10.5	387	104	74	98	32	
11.5	364	96	77	111	18	
12.5	480	94	80	126		
13.5	364	112	85	103		114
14.5	417	133	91	98		127
15.5	235	145	94	63		81

The means from each study for stature, weight, arm girth, and hip width are given in tables 1 and 2. Table 1 places Le Riche's values on South African Bantu schoolboys in juxtaposition with those of Meredith on North American schoolboys of Northwest European descent. Table 2 presents the means on North American schoolboys of Italian (Matheny and Meredith), Chinese (Wong and Lee, Preston) and Negro ancestry (McLendon); and compares each series with the South African Bantu values. Selected findings from these tables are:

1. At 7 years of age, the South African Bantu schoolboys are shorter than the North American schoolboys of Chinese, Italian and Northwest European ancestry by approximately 0.5 cm, 5.0 cm and 9.5 cm, respectively. Compared with Bantu boys at age 15 years, the North American boys are taller by 5.0 cm for those of Chinese lineage, 10.0 cm for those of Italian descent, and 16.0 cm for those of Northwest European stocks.

2. Compared with the South African Bantu schoolboys age 7 years, the North American schoolboys are heavier by about 0.5 kg, 2.8 kg and 4.8 kg for the Chinese, Italian, and Northwest European groups, respectively. At age 15 years, the Bantu mean is less than the North American means by 5.9 kg

(Chinese), 9.5 kg (Negro), 10.7 kg (Italian) and 14.7 kg (Northwest European).

3. Arm circumference at age 7 years is smaller for the South African Bantu schoolboys than for the North American schoolboys of Chinese, Italian and Northwest European

TABLE 1

Stature, weight, arm girth, and hip width: means for South African Bantu schoolboys (Le Riche) compared with means for North American schoolboys of Northwest European ancestry (Meredith).

MIDPOINT OF AGE GROUP	BANTU MEAN	NORTHWEST EUROPEAN MEAN	N. EUR. MINUS BANTU	BANTU MEAN	NORTHWEST EUROPEAN MEAN	N. EUR. MINUS BANTU
(yrs.)		*Stature (cm)*			*Weight (kg)*	
6.5	111.5	120.6	9.1	19.2	23.2	4.0
7.5	116.8	126.9	10.1	20.5	26.2	5.7
8.5	121.5	132.6	11.1	22.2	29.1	6.9
9.5	124.5	137.8	13.3	23.5	32.0	8.5
10.5	129.5	142.7	13.2	26.1	34.9	8.8
11.5	133.1	147.4	14.3	28.2	37.9	9.7
12.5	137.6	152.5	14.9	30.6	41.5	10.9
13.5	142.9	159.0	16.1	33.7	46.8	13.1
14.5	147.9	164.8	16.9	37.2	52.1	14.9
15.5	154.3	169.3	15.0	42.5	57.0	14.5
		Arm girth (cm)			*Hip width (cm)*	
6.5	14.8	17.8	3.0	17.5	19.4	1.9
7.5	14.9	18.3	3.4	18.1	20.2	2.1
8.5	15.2	18.9	3.7	18.6	21.0	2.4
9.5	15.6	19.6	4.0	19.0	21.8	2.8
10.5	16.2	20.3	4.1	19.8	22.5	2.7
11.5	16.5	21.0	4.5	20.1	23.1	3.0
12.5	17.2	21.5	4.3	20.8	23.9	3.1
13.5	17.9	22.2	4.3	21.6	25.0	3.4
14.5	18.7	23.3	4.6	22.3	26.1	3.8
15.5	19.9	24.5	4.6	23.3	27.0	3.7

descent by 0.2 cm, 2.4 cm and 3.2 cm, respectively. Compared with the mean arm girth of South African Bantu boys age 15 years, the means from North American boys are larger by 1.5 cm in the case of Chinese ancestry, and by upwards of 4.0 cm for the Negro, Italian, and Northwest European stocks.

4. At 7 years of age, the South African Bantu schoolboys are narrower in hip width than the North American schoolboys by 0.6 cm in the case of Chinese lineage and by 2.0 cm in the case of Northwest European lineage. At 15 years of age, hip width means on the North American samples exceed the mean on the Bantu sample by 1.6 cm (Negro), 3.3 cm (Italian), and 3.7 cm (Northwest European).

TABLE 2

Stature, weight, arm girth, and hip width: means for North American schoolboys of Italian (Matheny and Meredith), Chinese (Wong and Lee, Preston) and Negro descent (McLendon) and the differences between these means and the Le Riche means for South African Bantu schoolboys.

MIDPOINT OF AGE GROUP	STATURE (CM)		WEIGHT (KG)		ARM GIRTH (CM)		HIP WIDTH (CM)	
	Italian mean	D[1]	Italian mean	D[1]	Italian mean	D[1]	Italian mean	D[1]
(yrs.)								
6.5	116.2	4.7	21.6	2.4	17.1	2.3	19.3	1.8
7.5	122.1	5.3	23.7	3.2	17.4	2.5	20.1	2.0
8.5	127.2	5.7	26.0	3.8	17.8	2.6	20.7	2.1
9.5	132.2	7.7	28.4	4.9	18.4	2.8	21.4	2.4
10.5	137.2	7.7	30.8	4.7	19.0	2.8	22.1	2.3
11.5	142.1	9.0	34.1	5.9	19.7	3.2	22.8	2.7
12.5	147.2	9.6	38.6	8.0	20.8	3.6	23.7	2.9
13.5	152.5	9.6	43.3	9.6	21.8	3.9	24.7	3.1
14.5	158.3	10.4	48.0	10.8	23.0	4.3	25.7	3.4
15.5	164.0	9.7	53.2	10.7	24.3	4.4	26.6	3.3
	Chinese mean	D[1]	Chinese mean	D[1]	Chinese mean	D[1]	Chinese mean	D[1]
6.5	112.4	0.9	19.6	0.4	15.0	0 2	18.1	0.6
7.5	117.1	0.3	21.1	0.6	15.2	0.3	18.8	0.7
8.5	122.5	1.0	23.4	1.2	15.8	0.6	19.5	0.9
9.5	127.0	2.5	25.2	1.7	16.3	0.7	20.0	1.0
10.5	131.3	1.8	27.6	1.5	16.9	0.7	20.7	0.9
11.5	135.8	2.7	29.7	1.5	17.4	0.9	21.5	1.4
12.5	140.7	3.1	33.3	2.7	18.1	0.9		
13.5	147.6	4.7	38.0	4.3	18.9	1.0		
14.5	153.1	5.2	42.5	5.3	19.9	1.2		
15.5	159.5	5.2	49.0	6.5	21.7	1.8		
	Negro mean	D[1]	Negro mean	D[1]	Negro mean	D[1]	Negro mean	D[1]
13.5	153.6	10.7	41.8	8.1	21.7	3.8	23.2	1.6
14.5	160.3	12.4	47.2	10.0	23.1	4.4	24.1	1.8
15.5	164.8	10.5	51.5	9.0	24.0	4.1	24.8	1.5

[1] Preceding mean minus Bantu mean.

5. For all four measurements taken together, body size is smallest for the South African Bantu schoolboys and largest for the North American schoolboys of Northwest European descent. In relation to the North American Negro boys, the boys of Italian descent are shorter in stature, heavier in weight, similar in arm girth, wider in bi-iliocristal hip diameter.

6. On the whole, the differences in stature, weight, arm girth, and hip width between the South African Bantu schoolboys and the North American schoolboys of the White and Mongoloid races increase in magnitude over the age period from 7 to 15 years. In other words, there is a gradual divergence during childhood of the central tendency trends.

While the number of North American studies treating arm girth, hip width, stature and weight is small, the number treating stature is much larger. Consequently, Le Riche's means for stature may be compared with a more varied series of North American investigations than has been possible for the four measures considered jointly. In table 3 nine additional comparisons are presented — six based upon stature data collected during the decade 1930–39 and three based upon data accumulated prior to 1910. The samples will be described in the same order as arranged in the table.

The means for "Japanese (1930–38)" represent composite values derived from investigations by Lloyd-Jones ('41), Preston ('36) and Suski ('33). Preston's data were gathered during the winter of 1931 at "language and church schools" in San Francisco. The data of Suski and Lloyd-Jones were amassed 1930–38 at public and private schools in Los Angeles.

The means for "Navaho Indian (1931–35)" are from Steggerda and Densen ('36). They are based on data "collected from schools in the Navaho reservation in New Mexico and Arizona" ('36, p. 115): Schoolboys "known to have any White blood were excluded." Data amassed by Lloyd-Jones ('41) and Manuel ('34) were used to derive the means for "Mexican (1930–38)." Manuel's records were obtained during the spring of 1930 at schools in Laredo and El Paso,

TABLE 3

Stature (cm): means for nine groups of North American schoolboys, the numbers measured at each age, and the differences between each series of North American means and the Le Riche means for South African Bantu schoolboys.

MIDPOINT OF AGE GROUP	N	MEAN	D[1]	N	MEAN	D[1]	N	MEAN	D[1]
	Japanese (1930–38)			Navaho Indian (1931–35)			Mexican (1930–38)		
(yrs.)									
6.5	134	113.1	1.6	88	118.4	6.9	1124	115.5	4.0
7.5	210	118.2	1.4	116	123.3	6.5	1279	121.0	4.2
8.5	277	123.6	2.1	137	128.4	6.9	1404	126.0	4.5
9.5	266	128.6	4.1	164	133.2	8.7	1377	130.9	6.4
10.5	237	133.3	3.8	169	137.1	7.6	1430	135.7	6.2
11.5	240	138.4	5.3	169	140.9	7.8	1382	140.9	7.8
12.5	232	144.4	6.8	191	146.1	8.5	1196	146.6	9.0
13.5	215	151.0	8.1	196	151.5	8.6	1026	152.9	10.0
14.5	190	157.6	9.7	164	157.0	9.1	841	158.8	10.9
15.5	178	162.0	7.7	118	163.0	8.7	643	163.6	9.3
	Negro (1936–38)			Dutch (1931–35)			Polish (c. 1938)		
6.5	180	118.8	7.3	182	120.3	8.8	2245	116.3	4.8
7.5	198	124.4	7.6	226	126.2	9.4	2167	121.3	4.5
8.5	208	129.9	8.4	226	131.9	10.4	1977	127.0	5.5
9.5	208	135.0	10.5	206	137.0	12.5	1841	132.6	8.1
10.5	223	139.3	9.8	190	141.8	12.3	1839	137.2	7.7
11.5	257	144.3	11.2	186	147.1	14.0	1816	141.5	8.4
12.5	248	150.2	12.6	183	152.6	15.0	1673	146.2	8.6
13.5	218	158.3	15.4	187	158.7	15.8	1192	150.9	8.0
14.5	203	164.9	17.0	170	165.4	17.5	621	156.1	8.2
15.5	180	168.3	14.0				236	161.5	7.2
	Negro (c. 1898)			Irish (c. 1875)			Italian (1908–10)		
6.5	159	114.7	3.2	503	111.1	— 0.4	87	108.1	— 3.4
7.5	267	119.1	2.3	562	115.8	— 1.0	68	113.0	— 3.8
8.5	295	123.2	1.7	588	121.2	— 0.3	69	117.2	— 4.3
9.5	319	127.5	3.0	556	126.2	1.7	72	124.7	0.2
10.5	303	131.1	1.6	571	131.1	1.6	102	129.3	— 0.2
11.5	278	134.6	1.5	548	134.9	1.8	137	134.2	1.1
12.5	303	139.7	2.1	497	139.3	1.7	218	137.0	— 0.6
13.5	301	144.9	2.0	463	144.0	1.1	196	142.2	— 0.7
14.5	251	150.0	2.1	334	149.5	1.6	154	147.5	— 0.4
15.5	172	156.5	2.2	155	155.3	1.0	73	151.5	— 2.8

[1] Preceding mean minus Bantu mean.

Texas; those of Lloyd-Jones in Los Angeles' schools 1936–38. Manuel stated that individual Mexican boys varied "all the way from pure White (largely Spanish) to pure Indian" ('34, p. 237).

In the middle section of table 3 are means captioned "Negro (1936–38)"; "Dutch (1931–35)"; and "Polish (c. 1938)." The Negro values are from Lloyd-Jones ('41), the Dutch from Steggerda and Densen ('36) and the Polish from Courtis ('39). They represent, consecutively, Negro boys measured in Los Angeles' schools, boys "whose ancestors came from the Netherlands" measured in the schools of Holland, Michigan, and boys of Polish descent measured in the schools of Hamtramck, Michigan.

The lower third of the table carries the three series of means from stature data accumulated prior to 1910. The Negro series is reproduced from MacDonald (1899), the Irish series from Bowditch (1877) and the Italian series from Boas ('11). The groups portrayed are "colored" schoolboys residing in Washington, D. C., about 1898; schoolboys of Irish parentage living in Boston around 1875; and schoolboys of south Italian ancestry residing in New York City ("Chatham Square . . . the upper east side . . . and Yonkers") 1908–10. Boas specified that his subjects were American-born children of parents from "that part of Italy south of Rome . . . mainly Sicilians and Neapolitans" ('11, pp. 1, 56).

On inspection of table 3 in conjunction with tables 1 and 2, a large number of comparative findings for stature manifest themselves. It will suffice to specify three:

1. In relation to the North American schoolboys of Italian ancestry studied 1908–10 and 1938–39, Le Riche's ('44) South African Bantu schoolboys are as tall or taller than the former, but appreciably shorter than the latter. At 7 years of age, the Bantu boys are 3.5 cm taller than the "Italian (1908–10)" and 5.0 cm shorter than the "Italian (1938–39)." At 10 years of age, the means from the earlier Italian and Bantu samples

are identical, whereas the mean from the later Italian sample is higher by 7.7 cm.[2]

2. Similarly, the South African Bantu schoolboys are much shorter than the North American schoolboys of Northwest European ancestry measured 1930–39, yet differ little from the North American schoolboys of Irish parentage measured prior to 1877. Compared with the "Irish (c. 1875)" boys, the Bantu boys average about 0.5 cm taller at ages 7 and 8 years and 1.5 cm shorter at ages 10 to 15 years: Compared with the "Northwest European (1930–39)" boys, the Bantu boys are shorter by 9.5 cm at 7 years, 13.0 cm at 10 years, and 16.0 cm at 15 years.[3]

3. The South African Bantu schoolboys recently studied by Le Riche are shorter than any of the groups of North American schoolboys studied during the decade 1930–39. The difference values vary markedly with racial selection. About 10 years of age, for example, they are 2.0 cm (Chinese), 4.0 cm (Japanese), 6.0 cm (Mexican), 8.0 cm (Navaho Indian and Polish), 10.0 cm (Negro) and 12.0 cm (Dutch). There also are variations with age: at 7 years, difference values lie in the vicinity of 0.5 cm (Chinese), 1.5 cm (Japanese), 4.0 cm (Mexican), 4.5 cm (Polish), 6.5 cm (Navaho Indian) and 9.5 cm (Northwest European); at 15 years, they approximate 5.0 cm (Chinese), 7.5 cm (Polish), 8.5 cm (Japanese), 9.0 cm (Navaho Indian), 10.0 cm (Mexican) and 16.0 cm (Northwest European).

SUMMARY

A recent study of South African Negroid schoolboys is compared with a number of studies on North American school-

[2] For a table illustrating the increase in stature over the last half century, with particular reference to North American schoolboys of Italian descent and low socio-economic status, the reader is referred to a paper by Meredith ('41a).

[3] The two North American studies involved in these comparisons differ socio-economically as well as secularly. The earlier sample was drawn almost entirely from the unskilled to skilled occupational groups, the later predominantly from the professional and managerial groups. For a discussion of the magnitude of socio-economic and secular variations among North American schoolboys of Northwest European stocks, see Meredith ('41a) and Meredith and Meredith ('44).

boys of White, Mongoloid, and Negroid stocks. Thirteen series of comparisons are made for stature, and four series each for weight, arm girth, and hip width. Attention is restricted throughout to central tendency (Explicity, to mean values). It is found that:

1. South African Bantu schoolboys 7 years of age are slightly taller than Boston boys of Irish parentage studied around 1875; slightly shorter than San Francisco boys of Chinese lineage studied 1931–35; 2 inches shorter than Hibbing (Minnesota) boys of Italian descent studied 1938–39; and 3 inches shorter than Los Angeles boys of "Negro" ancestry studied 1936–38. Compared with North American schoolboys 15 years of age, the South African Bantu boys are shorter than groups of Irish and Negro ancestry studied prior to 1900 by less than an inch; shorter than groups of Chinese and Polish ancestry studied 1931–38 by 2 and 3 inches, respectively; shorter than groups of Japanese and Navaho Indian ancestry studied 1930–38 by approximately 3½ inches; and shorter than groups of Italian and Northwest European ancestry by 4 and 6 inches, respectively.[4]

2. Recently measured South African Bantu schoolboys at age 10 years are smaller in weight, arm girth, and hip width than North American schoolboys studied in the decade 1930–39. Aligned successively with North American boys of Chinese, Italian and Northwest European descent, the Bantu boys are lighter in weight by 3, 10 and 17 pounds; smaller in arm circumference by ¼ inch, 1 inch, and 1½ inches; and nar-

[4] Recently the writers' attention was called to an unpublished study on Pueblo Indian children (Pitney, Elizabeth H. 1940 The physical size and growth of Pueblo Indian children, Ph.D. Dissertation, Yale Univ.). Collection of these data took place in day schools during the years 1931–34. "The children studied came from 16 pueblos in the Rio Grande valley of New Mexico and 9 Hopi villages in northwest Arizona" (p. 150). Their economic level was "somewhat above subsistence," their diet "inadequate in both quantity and quality," their morbidity and mortality "high" ("especially in infancy and young childhood," p. 17). At 7 and 8 years of age the stature means of the Pubelo Indian boys ($N = 211$ at each age) were practically identical with those of the South African Bantu boys. At 10 and 15 years of age the Pueblo means (N's $= 220$ and 54) exceeded the Bantu means by approximately ¾ inch and 1 inch, respectively.

rower in hip width by $\frac{1}{3}$ inch, barely 1 inch, and slightly more than 1 inch. At 15 years of age, the North American groups of Chinese, Italian and Northwest European ancestry are heavier than the South African Bantu boys by 13, 24, and 32 pounds, respectively.

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DEFINITION OF PHYSICAL GROWTH.— It appears that no "useful and significant distinction" has yet been drawn between the physical growth of the child, the physical development of the child, and the physical maturation of the child. Consequently. . . it is justifiable to conclude that the three terms are appropriately regarded (at least for the present) as equal in scope and as fully interchangeable. From the standpoint of economy in writing and printing, "physical growth" has the advantage of being the shortest of the three terms. . .

What is physical growth? It is the sequence of somatic modification which a biologic organism undergoes during its ontogenetic life history. More explicitely, and with particular reference to the subclass of mammals that includes the human organism, physical growth may be defined as the entire series of anatomic and physiologic changes taking place between the beginning of prenatal life and the close of senility.

Basically, these definitions emanate from a twofold objective: To delimit the sector of science that students of physical growth investigate, and to embrace both its explored and unexplored areas. This objective will be seen to be realized by the restriction of physical growth to somatic (anatomic and physiologic) changes, and by the identification of physical growth with nothing less than the whole gamut of such changes. — Howard V. Meredith. Toward a working concept of physical growth. Am. J. Orthod. and Oral Surg., vol. 31, 1945, pp. 440–458.

ORIGINAL PRIMATE VERTEBRAL FORMULA.— The common ancestor of all primates in all likelihood possessed 7 cervical, 13 thoracic, 6 lumbar, 3 sacral, and about 25 caudal vertebrae. This original vertebral formula has become phylogenetically altered for one or several spinal regions and in various degrees in the great majority of the recent genera of primates. . . — Adolph H. Schultz and William L. Straus, Jr. The numbers of vertebrae in primates. Proc. Am. Philos. Soc., vol. 89, no. 4, 1945.

CHEST CIRCUMFERENCE CHANGES AS A RESULT OF SEVERE PHYSICAL TRAINING

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INTRODUCTION

An opportunity to observe the effect of a severe physical training period on certain external morphological characteristics in a group of aviation cadets, presented itself at a large pre-flight station of the U. S. Armed Forces in the summer of 1943. The present report deals with changes indicated in the measurement of the chest circumference.

Chest circumference measurements were made on 272 cadets at the beginning and at the end of the physical training period of 8 weeks duration. The training period was continuous, involving an elaborate and strenuous physical conditioning program which occupied the major part of the cadet's time. The average age of the cadets was about 21 years and they represented a selected group of individuals insofar as their membership in this branch of the armed forces was based on stringent medical and physical requirements. It should also be noted that on reaching this stage of the aviation program the great majority of the cadets had already been subjected to varying degrees of physical conditioning. Physical fitness indices were obtained before and after the training period by means of the Step Test (Johnson, Brouha and Darling, '42; Brouha, Graybiel and Heath, '43). At the beginning of the training period the average physical fitness index of the group of cadets was 73 and ranged from 35 to 101. At the end of the training period a substantial improvement was recorded with the average physical fitness index rising to 82 and the range now running from 61 to 114.

Chest circumference was measured by means of a steel tape at the level of the nipples, and the measurement taken with the chest at rest between maximum inspiration and expiration.[1] Although in the taking of this measurement there exists the factor of the personal equation of the observer, the fact that both series of measurements at the beginning and at the end of the training period were made only by the author, eliminates at least the problem of the personal equation of different observers.

ANALYSIS AND DISCUSSION

The average increase in chest circumference during training was 0.60 cm. About twice as many cadets showed an increase in chest circumference as a result of the training period than those who presented a decrease. If we consider only those cadets whose changes in chest circumference was greater than 0.5 cm we find that out of 272 cadets 145 or 53% show an increase in this chest measurement, while 76 or 28% displayed decreases (table 1).

Decreases in chest circumference were usually associated with a loss in weight. Thus (table 2) of the 37 cadets who showed a decrease in chest circumference of 1.5 cm and more, 35 or 94.6% lost weight during this period. The average loss of weight for this group was 9.6 lbs. Of the cadets who showed an increase in chest circumference of 2 or more centimeters only 50% showed a loss of weight. Thirty-six per cent had weight gain and 13% showed no change. The average loss of weight of the individuals who showed this marked increase in chest circumference was 4.8 lbs.

There was no marked superiority in physical fitness index gain for those cadets who showed large increases in chest circumference. Of the cadets whose chest circumference had increased 2 or more centimeters, 80% showed a gain in physical fitness scores, 16% showed a decrease and 3% exhibited no change at all. Similar proportions were found in the cadets who showed a decrease in chest circumference of 1.5 cm or

[1] Mean chest circumference for the group of 272 cadets is 88.90 cm with a standard deviation of 4.75.

more. Of these latter thirty-seven cadets, 86% gained in physical fitness, 11% and 3% are unchanged. It should be noted, however, that the group of cadets with decreases in chest circumference showed much larger average gain in physical fitness than those cadets whose chest circumference increased.

TABLE 1

Changes in chest circumference (at rest) during training period.

CHEST CIRCUMFERENCE	FREQUENCY
cm	
x to +5.3	5
+5.2 to +4.8	7
+4.7 to +4.3	2
+4.2 to +3.8	7
+3.7 to +3.3	4
+3.2 to +2.8	10
+2.7 to +2.3	16
+2.2 to +1.8	21
+1.7 to +1.3	22
+1.2 to + .8	38
+ .7 to + .3	27
+ .2 to — .2	26
— .3 to — .7	16
— .8 to —1.2	16
—1.3 to —1.7	20
—1.8 to —2.2	18
—2.3 to —2.7	7
—2.8 to —3.2	2
—3.3 to —3.7	4
—3.8 to —4.2	2
—4.3 to —4.7	1
—4.8 to —5.2	1
	272
Mean +.60	

This may be attributed in part to the fact that the large gains in physical fitness index were found in those individuals who were originally overweight and subsequently lost considerable poundage.

Original size of the chest seems to play some role in extent of circumference changes as a result of the strenuous conditioning

TABLE 2

Chest circumference changes as associated with weight and physical fitness index changes.

Weight

Cadets with 2.0+ cm. *increase* in chest circumference.

	No.	%	
Lost weight	31	50.8	Av. loss = 4.8 lbs.
Gained weight	22	36.1	Av. gain = 2.8 lbs.
No change	8	13.1	
	61	100.0	

Cadets with 1.5+ cm *decrease* in chest circumference.

	No.	%	
Lost weight	35	94.6	Av. loss = 9.6 lbs.
Gained weight	2	5.4	Av. gain = 2.0 lbs.
No change	0	0.0	
	37	100.0	

Physical fitness index

Cadets with 2.0+ cm *increase* in chest circumference.

	No.	%	
Gain in P.F.I.	49	80.3	Av. gain = 9.1
Loss in P.F.I.	10	16.4	Av. loss = 4.9
No change	2	3.3	
	61	100.0	

Cadets with 1.5+ cm *decrease* in chest circumference.

	No.	%	
Gain in P.F.I.	32	86.5	Av. gain = 15.4
Loss in P.F.I.	4	10.8	Av. loss = 3.2
No change	1	2.7	
	37	100.0	

TABLE 3

Size of chest circumference and extent of changes as a result of the training period.

CHEST CIRCUMFERENCE CHANGES	CHEST CIRCUMFERENCES BELOW 86 CM		CHEST CIRCUMFERENCES 92 CM AND HIGHER	
	No.	%	No.	%
Increase	33	67.3	44	49.4
No change	3	6.1	3	3.4
Decrease	13	26.5	42	47.2
	49	99.9	89	100.0
Average increase (cm)	1.6		2.1	
Average decrease (cm)	1.7		1.9	

program (table 3). If we compare the individuals with small chest circumferences (below 86 cm) to those with large chest circumferences (92 cm and greater), we find that the smaller-chested persons more frequently showed increases in chest circumference at the end of the training period than the larger-chested individuals. However, the average change in this chest dimension is greater in the larger-chested cadets whether it assumes the form of an increase or a decrease in this feature.

CONCLUSIONS

It may be concluded that the general effect of the training period is to increase the chest circumference of the cadet. Gain in chest circumference evidently is no criterion of improved physical fitness (except perhaps in markedly underdeveloped individuals). Decreases in chest circumference are usually associated with considerable loss of body weight. In many instances even when there is loss of body weight the net effect of the training period is so marked as to result in some chest circumference increase. It is doubtful whether the increase of chest circumference in the cadets is a reflection of any skeletal modifiations. Such changes as have taken place are most probably due to a greater development of the thorax musculature, increased tonus of these muscles, and improvement in bodily posture.

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The Fels Research Institute, Yellow Springs, Ohio, announces the construction, on the Antioch College Campus, of a new building, to house all the departments of the Institute. The new plant will cost

about $400,000, exclusive of equipment, and will provide facilities for continuing the longitudinal study of human growth and development which the Institute has been conducting since 1929. The disciplines so far represented at Fels Institute include medicine, physical anthropology, biochemistry, physiology, psychology and genetics.

The work of the Institute is divided among four departments: physical growth, biochemistry-physiology, psychology and genetics. Of particular interest to physical anthropologists is the physical growth department, whose chairman is Dr. Earle Reynolds. The facilities provided for this department will contain x-ray laboratory and dark-room, two anthropometric rooms, photographic corridor, medical and dental examining rooms, eye and ear test room, x-ray reading room, and a statistical work-room, in addition to the staff offices. The other departments will contain comparable facilities, and the building will also have a nursery school, lecture rooms and library.

When completed, the new Fels Institute building will offer ideal physical facilities for the integrated study of human development. The Fels research program may be defined briefly as an intensive study of human ontogeny, based on regularly repeated measurements and observations of a normal human population. The same individuals are thus studied from fetal life through maturity. The cooperation of many disciplines is necessary in order to produce a comprehensive picture of human development.

Six internships have been created, to be available annually to graduate students working toward advanced degrees in any accredited university in the fields of psychology, psychophysiology, physical growth and biochemistry. They will provide an annual stipend of $1200.

A new scientific advisory board has been created, consisting of Dr. Robert Yerkes, Yale, psychobiology; Dr. Ashley Weech, Cincinnati University, pediatrics; Dr. E. V. Cowdry, Washington University, anatomy; and Dr. Maurice Visscher, University of Minnesota, physiology. The Institute, established in 1929, is under the direction of Dr. L. W. Sontag.

Buried Reference in Physical Anthropology.— The pernicious bibliographic custom of not listing appendical papers on the title page covering the whole publication turns up again in Ibero-Americana: 25, 1945. The losing physical anthropologist this time is F. S. Hulse. His report on *Skeletal material* [*from the excavations at Culiacán, Sinaloa*] is lost under the general title of Isabel Kelly's monograph.

DERMATOGLYPHICS IN ESKIMOS OF WEST GREENLAND

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ONE FIGURE

This reports an analysis of finger prints and palmar configurations in the fourth series of Eskimos investigated from the standpoint of dermatoglyphics. Comparisons are made with data from the previous studies, toward the end of evaluating the characteristics of the Eskimo, but for discussion of broader racial relationships the reader is referred to Cummins and Midlo ('43).

The first group of Eskimos to be studied consisted of 64 individuals chiefly from St. Lawrence Island (Midlo and Cummins, '31), all subjects except one being full-blooded. The sexes were about equally represented, though in view of the small number the data were not separated for sexual comparisons. Next there was reported a series of 68 full-blooded Eskimos of the east coast of Greenland, supplemented by a group of 14 Dane-Eskimo hybrids (Abel, '33a). Again, the sexes were not separately analyzed; males and females were about equal in number. Fifty-five individuals from Point Barrow were next reported (Cummins, '35).

[1] The prints upon which the study is based were collected in 1939 by Fabricius-Hansen, aided by a grant from the Carlsberg Foundation. Cummins is responsible for analysis of the prints and for the published report. We are indebted to Dr. P. O. Pederson, heading the Third Greenland Dental Expedition (of the Dental School of Copenhagen), for his interest and cooperation in securing this material.

White or Indian admixture was known or suspected in about one-third of the cases. Males outnumbered females in the proportion 2.4: 1.

The series now presented includes 145 subjects, 66 males and 79 females, from West Greenland. (Lesser totals indicated in tabulated data result from the omission of prints which are indecipherable or incomplete in critical regions.) A brief preliminary note, on the finger prints alone, has been published (Fabricius-Hansen, '40). The subjects are from the district south of Julianehaab, on the southwestern coast of Greenland. The population is not pure Eskimo, but the degree and kind of racial admixture in the individual cases have not been ascertained. Family members are included in the series. Although the relationships are on record, the entire material has been pooled without regard to these data. The accession numbers in the senior author's file are 7954–8098 inclusive. Data too extensive for publication (tables 4–23) are deposited in The Wistar Institute of Anatomy and Biology.

OBSERVATIONS

Finger prints

Pattern types. The pattern types, classified according to the arch-loop-whorl method of Galton, occur in the following frequencies: whorls, 42.5% ; ulnar loops, 50.5% ; radial loops, 3.6% ; arches, 3.5% (table 1). These frequencies differ but slightly from the values in the St. Lawrence Island and Point Barrow series, but they are markedly discrepant from Abel's data on Eskimos of East Greenland, where the incidences of whorls and arches are 72.2% and 0.8% respectively. This West Greenland series, like the St. Lawrence Island and Point Barrow groups, is closer to Abel's Dane-Eskimo hybrids, although the very small number composing this last-named sample calls for guarded interpretation.

The same order of comparison of the five series is resolved from the index of pattern intensity (table 1). This index (Cummins and Steggerda, '35) is merely a statement of the

number of triradii in the individual, or the mean number in a group of individuals.

The combinations of pattern types in individuals, as recorded in manuars (tables 9–11), show nothing worthy of note.

In keeping with findings in other population samples, whorls are especially concentrated in digits I and IV (tables 4–6). When the data for pattern-type frequencies of individual digits are plotted in the form of Poll's dactylodiagram ('38) the result is a depressed and extended graph (fig. 1),

TABLE 1

Finger print pattern types in all the reported series of Eskimos, arranged in descending order of the indices of pattern intensity.

NUMBER OF SUBJECTS, AND SOURCE OF EACH SERIES	INDEX OF PATTERN INTENSITY ± P. E.	WHORLS	ULNAR LOOPS	RADIAL LOOPS	ARCHES
		%	%	%	%
68, East Greenland (Abel)	17.13	72.2	26.2	0.7	0.8
30, Point Barrow (Cummins)	14.39 ± .40	46.3	49.0	2.3	2.3
59, St. Lawrence Island (Midlo and Cummins)	14.25 ± .35	46.8	46.9	1.9	4.4
140, West Greenland (this series)	13.95 ± .19	42.5	50.5	3.6	3.5
14, East Greenland (Dane-Eskimo hybrids, Abel)	12.91	34.2	57.1	5.6	5.0

agreeing in general outline with that obtained in other series of Eskimos and conforming to what Poll (in correspondence) was accustomed to term the "mongoloid" type.

Poll has stressed the occurrence of two unlike digital distributions of pattern types, coining terms to describe them: the pair-group rule and the rule of all pairs. In a population conforming to the pair-group rule the frequencies of whorls and of arches on digits I and IV of the same hand are closer numerically than are the frequencies of these patterns on corresponding digits of opposite hands. Digits I and IV of the same hand thus constitute a "group," as distinguished from the "pairs" represented by the remaining digits, each

of which presents whorls and arches whose frequencies are close to those of its mate on the other hand. A population adhering to the rule of all pairs differs in that all digits, including I and IV, bear numbers of whorls and arches which agree closely in pairs of corresponding digits.

The dactylodiagram (fig. 1) and the per cent frequencies listed in table 4 show conformity to the rule of all pairs, although the pattern frequencies in digits I and IV when "paired" are but slightly closer than in these digits as a "group" in the same hand. Examination of the sexes sepa-

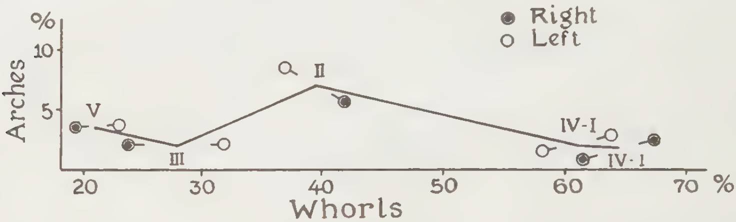

Fig. 1 A dactylodiagram (Poll's method) of the West Greenland series of Eskimos, sexes combined. Digit by digit, the frequencies of whorls are plotted against the frequencies of arches and the curve is drawn between the successive points representing mean values for the five couplets of digits ("pairs" V, III, II; "groups" IV–I left and IV–I right).

rately (tables 5–6) discloses that the trend toward the rule of all pairs is introduced largely by the females (where there is no bilateral difference of whorl frequency in digits I and IV). The sexual distinction here noted is of special interest in the light of similar findings in certain other racial samples: Chinese, Japanese and Koreans (Poll, personal communication, March 23, 1939). From the standpoint of racial comparison, it may be added that North American Indians conform to the rule of all pairs (Cummins, '41).

The usual sex differential of more frequent whorls in males does not appear. Females have an index of pattern intensity (14.19 ± .25) higher than that of males (13.71 ± .30), although the difference is statistically insignificant.

Pattern size (Quantitative value, Bonnevie). Pattern size in loops is measured by the conventional ridge count from

triradial point to point of core. In whorls, the larger of the two possible counts is selected as the indicator of size. Arches have zero ridge counts. The mean count, combining right and left hands of 63 males and 63 females, is 14.98 ± .14 (standard deviation, 7.13 ± .10). The counts in right hands (15.20 ± .19) average slightly higher than in lefts (14.76 ± .19); though the difference is statistically insignificant, the demonstration is in accord with bimanual differences exhibited in other populations. Females present a higher mean value (15.28 ± .18) than males (14.68 ± .20). The standard deviations suggest that females (6.73 ± .13) are less variable in this respect than males (7.50 ± .14).

In his material Abel ('33b) has emphasized the frequencies of the genotypes which can be determined from ridge counts: epidermal thickness (V), radial cushioning (R) and ulnar cushioning (U). The factors R and U display less variation among different peoples than does V (Cummins and Midlo, '43). For that reason, and because there is the possibility that workers may have applied unlike criteria in classifying R and U, only the determinations of V are considered here. In Abel's 68 full-blooded Eskimos there is an unparalleled high frequency of vv, 98%, with one instance representing a questionable Vv and no VV at all. In the present material the frequencies of the genotypes are: vv, 70.6%, Vv, 23.0%; VV, 6.3%. These figures are essentially identical with the values reported by Abel for Chinese.

Palmar patterns

The data on frequencies of palmar patterns (table 2, more detailed in tables 18–23) are not consistent among the five Eskimo series. There are significant departures from the stock represented by Abel's East Greenland material. Excepting the Thenar/Interdigital I configuration, the variants indicate a trend toward the Dane-Eskimo hybrid characters.

With regard to bimanual variation, it is to be noted that the hypothenar area does not display the usual dextral excess of patterns. The frequencies are: right, 28.4%; left,

TABLE 2

Frequencies of palmar patterns (true patterns and marked vestiges combined) in all the reported series of Eskimos, the series arranged in the same order as table 1. Sources as indicated in table 1.

SERIES	HYPO-THENAR	THENAR/INTER-DIGITAL I	INTER-DIGITAL II	INTER-DIGITAL III	INTER-DIGITAL IV
	%	%	%	%	%
68, East Greenland	20.7	4.4	1.5	48.1	60.7
53, Point Barrow	21.7	7.5	3.8	47.2	61.3
64, St. Lawrence Island	20.3	18.0	0.8	43.8	53.9
143, West Greenland (this series)	32.9	22.3	5.2	54.2	50.7
14, East Greenland (Dane-Eskimo)	28.6	7.1	7.1	60.7	53.6

37.2%. All other patterns exhibit characteristic bimanual differences of frequency.

Palmar main lines

Tallies of terminations of main lines (tables 13–14) and detailed comparative data on bimanual and sex differences of the main-line index (tables 16–17) are available. The main-line index, it will be recalled, is a summarizing value which indicates the degree of transversality of the configuration of the distal palm. The smaller the value of the index, the more the configuration slopes in approach to longitudinal alignment.

In both sexes, as is typical, right hands are distinguished by a larger index, the values being: Male — right, $9.44 \pm .15$, left, $8.44 \pm .16$; Female — right, $9.38 \pm .13$, left, $8.51 \pm .15$. It is evident that there is no sexual difference in this trait. With sexes combined the values are: right, $9.41 \pm .10$; left, $8.48 \pm .11$. The mean excess in right hands is about one unit of the index ($0.93 \pm .09$). In conformity to rule, right hands are less variable in respect to the index than are lefts. The coefficients of variation, with sexes combined, are 18 and 23 respectively. There is no significant difference in variability between the sexes (Male — right, 18, left, 22; Female — right, 17, left, 24).

The combined value, for right and left hands in both sexes, is $8.95 \pm .08$. The range of variation among the five Eskimo series is about one unit of the index (table 3), and this value is at the upper extreme together with Abel's Dane-Eskimo hybrids. Considering that the Eskimo belongs to the Yellow-Brown race, the low value of the St. Lawrence Island series ($8.00 \pm .14$) would be regarded as more nearly characteristic of the racial trend than the much larger index obtained in the present series.

TABLE 3

Palmar main-line indices in all the reported series of Eskimos, arranged in ascending order. Sources as indicated in table 1.

SERIES	MAIN-LINE INDICES $\pm$ P. E.
62, St. Lawrence Island	$8.00 \pm .14$
68, East Greenland	8.45
53, Point Barrow	$8.46 \pm .14$
143, West Greenland (this series)	$8.95 \pm .08$
14, East Greenland (Dane-Eskimo)	8.95

SUMMARY

Finger prints and palmar dermatoglyphics of 145 Eskimos of West Greenland are analyzed. All variants exhibit trends which are characteristic of Yellow-Brown stock. Three factors must be considered in explanation of the inconsistencies among the several recorded series of Eskimos: small size of the available samples; influences of racial admixture; inclusion of family members, which may have brought about departures from the characteristics of random samples.

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PRIMATE AND HUMAN VARIABILITY.— The principal distinguishing characteristic of the primates is their great variability. Probably no other order of mammals exhibits so great a variability, most striking is that family of the order to which man belongs, the Hominidae. Man is the most variable of all animals. This cannot be too strongly stressed, for its implications are of the greatest importance, while neglect of this fact has been responsible for untold numbers of errors.— M. F. Ashley Montagu. Physical Anthropology. In *Medical physics* (Ed. by Otto Glasser) The Year Book Publishers, Inc., Chicago, 1944, pp. 1014–1031.

MAN AN EVOLUTIONARY EXCEPTION.— It is a rule of evolution that new major types become dominant by branching out into lines of increasing specialization and that each specialization eventually comes to a dead end. Selection can push it no further along that line — it can merely ring minor changes upon the type by throwing off new species or genera. And when a new dominant type arises, it does so from an unspecialized member of the previously dominant group.

There is one exception to this — the human species. Man is now the dominant type of organism. He has not radiated out into wholly separate lines. His new capacities for conscious thought and purpose, on which his biological dominance depends, give him the possibility of establishing a common pool of consciousness. His specializations are learnt, not inherited biologically. If he set his mind to it, he could control not merely his natural and his social environment but his future biological evolution.— Julian S. Huxley. Species and evolution. Endeavour, vol. 5, no. 17, 1946, pp. 3–12.

REVIEWS

HUMAN ORIGINS: AN INTRODUCTION TO ANTHROPOLOGY (Anthropology 220 a, b, c). SELECTED READINGS SERIES I (lithoprinted, paper bound), University of Chicago Bookstore, 538 pp., 68 figs., 33 tables, 7 plates, 1945. ($4.00).

SELECTED READINGS SERIES II (hectographed, loose-leaf). University of Chicago Bookstore, 500 pp., 1 fig., 16 tables, 15 plates, 1945. ($4.50).

SYLLABUS OF GENERAL ANTHROPOLOGY. Part I. Human Origins, An Introductory General Course in Anthropology (Anthropology 220 a, b, c). University of Chicago Bookstore, 87 pp., 1945. ($1.00).

Selected Readings I and II contain 50 original and reprinted articles supplementing the required reading list in the first of three 1-year courses in General Anthropology at the University of Chicago. This course is Anthropology 220 — Human Origins, first given in 1945–46. The other two are Anthropology 230 — Peoples of the World, and Anthropology 240 — Culture, Society and the Individual. All three are a requirement for M.A. candidacy. Most of the introductory physical anthropology is given in Anthropology 220, with the rest in Anthropology 230.

Nineteen of the fifty articles, mostly in Selected Readings I, deal with physical anthropolgy. Their significance is immediately made clear to the student by a compact and lucid summary in the Syllabus of the major topics and pertinent literature. The student, therefore, need not wonder why he is readng an assigned article; he can find out by consulting the Syllabus.

Whereas Selected Readings I, II and the Syllabus were not designed as part of the working library of the professional physical anthropologist, they provide handy reference. All three will be revised for the Fall of 1946, and until then only Selected Readings I is in print. Especially useful to those teaching physical anthropology should be the Syllabus and the excellent and previously unpublished articles in Selected Readings II, by Snodgrasse and Otten (Laboratory Manual of Anthropometry) and Krogman (Human Evolution). Some will not be as pleased with all the selections in Selected Readings I and II.

It must be remembered, however, that publishers' copyright regulations, size and technicality of articles limit the field of selection. Many of the most authoritative general articles appear in bookform, and probably cannot be reprinted until the book loses sales volume, and incidentally timeliness.

In Selected Readings I the reviewer would prefer other use for the sixty-nine pages devoted to de Gobineau's ''The Inequality of Human Races.'' By all means mention de Gobineau and the classic and modern racists, but are sixty-nine pages of horrible example necessary? Wholly fortunate choices, in the reviewer's opinion, are: Schultz, ''Characters Common to Higher Primates and Characters Specific to Man''; Movius, selection from ''The Chronology of Northern Europe''; Galloway, ''Man in Africa . . . ''; von Koenigswald and Weidenreich, ''The Relationship Between Pithecanthropus and Sinanthropus''; Oppenoorth, ''The Place of Homo Soloensis Among Fossil Men''; McCown and Keith, selections from ''The Fossil People of Mt. Carmel''; Hooton, ''Methods of Racial Analysis''; Taylor, ''Racial Migration Zones and their Significance''; Dobzhansky, ''On Species of Living and Fossil Men''; Todd, ''Entrenched Negro Physical Features''; Strandskov, ''The Genetics of Human Population''; Mills, ''Climatic Effects on Growth and Development . . . ''; Krogman, ''The Inheritance of Non-Pathological Physical Traits in Man''; and Herskovits, ''Physical Types of West African Negroes.'' This completes the Selected Readings I list except for Keith, ''The Differentiation of Man into Racial Types,'' which the reviewer considers old but good. Zuckerman's ''Hormones and Evolution'' (Man, '36) might be a better choice, although it does not cover precisely the same field.

Chicago's Department of Anthropology should be congratulated for providing ''a comprehensive and general education in anthropology'' as a fitting prelude to more advanced work. The Selected Readings and Syllabus are not only part of excellent teaching methodology, but should prove useful to students and professionals not participating in Chicago's courses.

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GIANT EARLY MAN FROM JAVA AND SOUTH CHINA. By Franz Weidenreich. Anthrop. Papers Am. Mus. Nat. Hist., N. Y., vol. 40, pt. 1, 134 pp., 12 plates, 28 text figures, 19 tables, 1945. ($2.00).

The literature on recent discoveries of human fossils is being turned out almost exclusively by Doctor Weidenreich, and his industry is

everyone's good fortune. This latest monograph deals with the varied but important finds made by G. H. R. von Koenigswald: the Pithecanthropus IV calvaria and maxilla, the two fragments of mandibles from Sangiran, Java, found in 1939 and 1941 and the enormous molar teeth from South China named "Gigantopithecus" by von Koenigswald and bought by him in 1934 and 1939 in a Hong Kong apothecary shop. Although he had studied the Pithecanthropus IV skull at first hand, Doctor Weidenreich has had only casts of this and the rest of the material to work with in preparing his report, the casts of the two Sangiran mandibles arriving in New York just at the beginning of the war with Japan, when contact with Doctor von Koenigswald was lost. In order to allow von Koenigswald to describe his finds himself, Doctor Weidenreich at first forbore to publish a detailed study of them, but as the war went on and the material was becoming widely known in scientific circles without being officially in print, he decided that the best interests both of study and of future exploration would be served by publication, and accordingly he went ahead, with the Netherlands Indies government's consent and the certainty of von Koenigswald's approval.

The Pithecanthropus IV brain case has the general appearance of the other Pithecanthropus skulls but it is considerably larger and more massive, with a very pronounced sagittal elevation formed partly by peculiar knob-like areas. The mastoid processes are large, and slant inwards. On the maxilla there is a wide pre-canine diastema (6.2 mm on the left side) and the whole maxilla is big and strongly primitive (for man). The teeth are human in character; the canines are large but not particularly projecting. Pithecanthropus IV was originally accepted by Doctor Weidenreich as a male of the species, making the two previous adult specimens female, but he now considers that the great massiveness of skull IV, with its special form of sagittal ridge, goes beyond the limits of a mere sexual difference, and he prefers to set this specimen apart as a different type, suggesting it be called "Pithecanthropus robustus." His decision was reinforced by the maxilla, which he believes has features too primitive and simian-like to accompany the "female" skulls, Pithecanthropus I and II, which he finds to possess marked affinities with Sinanthropus; as evidence of his sporting blood, Doctor Weidenreich says he would not be surprised if the future brought forth a Pithecanthropus maxilla "without a diastema which may fit, in size and form, the Pithecanthropus Skulls I and II." If I understand him, Doctor Weidenreich puts Pithecanthropus I and II (erectus) somewhat nearer to Sinanthropus than to Pithecanthropus IV; he equates, as an evolutionary stage, Sinanthropus and Pithecanthropus erectus, and makes Pithecanthropus IV (robustus) an earlier, more primitive form of the latter. This rests, of

course, on the division of Pithecanthropus into two types, which is not entirely convincing on the basis of the actually comparable parts; remembering gorillas, it is not certain that we are in a position to know how wide sexual, or even racial, differences in Pithecanthropus might be.

The two mandibular fragments from Sangiran differ in character, according to Doctor Weidenreich, although von Koenigswald apparently considered them as probably male and female of the same species. The smaller, found in 1939, retains the first two molars and the alveoli of some of the teeth anterior to them, although the exact nature of the latter is obscure in the cast in Doctor Weidenreich's possession. The position of the canine is therefore equivocal, and makes it difficult to decide how closely the fragment approaches the symphyseal midline. The molars, though approximately square, are worn and do not help. The body of the mandible is larger than that of any previously known hominid, equalling an orang's in size. The symphyseal region appears human, but the base of the body is narrow as in apes, with no digastric fossa. Doctor Weidenreich does not believe that the fossil can be assigned at present, having only the cast, though he inclines to think that it represents an anthropoid.

It is the 1941 fragment, accepted as Meganthropus javanicus von Koenigswald, which he finds more significant. This huge jaw — still bigger than the other — is surpassed in diameter only by the largest male gorillas, and exceeds even them in the circumference at the molar region. In spite of its size, and certain peculiarities of its own, its features are definitely human: it is short, with little prognathism (apparently), there is a mental spine and no simian shelf, and the form of the arch and the position of the mental foramen are hominid in character. The remaining teeth (two premolars and first molar), though larger than in other human fossils, are of human type, although the molar is relatively long; and the alveolus for the canine indicates that this tooth was no larger than the largest known for Sinanthropus. There are no specific anthropoid traits in the bone, and it "must certainly be regarded as the most primitive hominid mandible so far discovered." Doctor Weidenreich believes Meganthropus to be a giant type, which does not differ "generically" from Pithecanthropus; indeed, Pithecanthropus IV (robustus), judging by its size, is closer to Meganthropus than to Pithecanthropus erectus.

If the Meganthropus jaw is huge, the teeth known as Gigantopithecus blacki are colossal, exceeding in crown volume all primate teeth on record. The specimens are a right and a left third lower molar, which are practically mirror images, and a right upper molar, possibly the first. Von Koenigswald took these teeth to be anthropoid, but Weidenreich introduces them into this paper because he considers

them to be unquestionably human, in spite of their extraordinary size, finding that they do not differ from the hominid pattern of the occlusal surface and that they also resemble human teeth in the general structure of the crown and the form of the individual cusps. At the same time, the great size and length of the lower molars is primitive, and they are peculiar in having an anterior breadth which is disproportionately greater than the posterior breadth; moreover there is a fossil orang, also from South China and probably contemporary, whose teeth furnish one of the few close resemblances to those of Gigantopithecus. Altogether, however, Gigantopithecus was a "typical hominid," probably derived from the middle or lower Pleistocene cave deposits of South China, on the evidence of other fossils obtained in the same apothecary shop. Doctor Weidenreich considers him a unique type, with no special likenesses to Meganthropus, and resembling Pithecanthropus somewhat more than Sinanthropus, compared with whom he actually shows certain advanced dental characters. Calculating from the size of the teeth by using known or probable ratios, Weidenreich concludes that Gigantopithecus must have had a skull far larger than the largest gorilla — though probably without a sagittal crest — but that he would not necessarily have been much taller than modern man, though having stronger leg bones and a heavier trunk. He supposes an erect posture, since Pithecanthropus and Sinanthropus indicate that this was attained early in man's development.

From all this material, so fragmentary but so greatly widening the known range of human (or anthropoid) morphology, one can make more or less what one wishes. What Doctor Weidenreich makes is an evolutionary, genetic line, from Gigantopithecus through Meganthropus, Pithecanthropus robustus and Pithecanthropus erectus, going on to the Solo and Wadjak men and the modern Australian. He prefers to rely on a morphological sequence, since the geological chronology of the several finds is not too clear, and it is believed that there may have been considerable redeposition of material in the Pleistocene of Java. The far end of this line (i.e., Meganthropus and Gigantopithecus) does not point to an immediate anthropoid ancestor of man among known forms, showing no particular kinship with one of the living apes nor with either the Dryopithecus-Sivapithecus group or the South African fossils. It does, however, demonstrate a giant stage in early hominid development, which was general and not particular; Doctor Weidenreich considers but rejects the possibility that the gigantic forms were specializations, and suggests that other giant hominids may yet come to light from the Pliocene of Europe. Weidenreich does not elaborate upon this giant stage; he has discussed

it before as a theoretical matter, and now offers the present material as evidence.

Readers may recoil from accepting as a direct ancestor every new hominid found in Asia, no matter how top-heavy, and will ask to see more definite indications than can be found in three teeth that such giants were not a special line. Irreversibility of evolution may not be sacrosanct, but the fact is that large mammal types of the Pleistocene generally became extinct, and did not father their living relatives. Doctor Weidenreich's predilection is for putting all fossil human beings into our direct line (or else to junk them, like Eoanthropus), but the chances are still as good for man as for other animals that his family has had sterile offshoots, particularly if these were giants. Apart from this, the hypothesis of gigantism and subsequent reduction raises more questions regarding human evolution — e.g. in the development of the foot, spine, posture, etc. — than can be suggested in this monograph. None of this, of course, is meant to discourage Doctor Weidenreich from his line of reasoning, or as anything but applause for adding again to the large body of original thought which has accompanied his writings.

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CRANIOMETRY OF AMBRYM ISLAND. By WILFRED D. HAMBLY. Fieldiana: Anthropology (Chicago Nat. Hist. Mus.), vol. 37, no. 1. 150 pp., 30 pl., 7 figs., 2 maps, 9 contour drawings, 1946.

As one scans this report one is overwhelmed by the numerous pages of statistical data. But as one studies this report one is impressed by a thorough, critical, and useful analysis. It is basically morphometric, but it acknowledges the corroborative contributions of morphology. As far as critical statistics are concerned the author employs the very acceptable $\triangle P_{\wedge}$ [$M_1 - M_2 > 3\sqrt{(PE_1)^2 + (PE_2)^2}$]. The CRL is referred to, but is not employed.

The report is based on 20 ♂ and 11 ♀ skulls from Ambrym Island in the New Hebrides group. Hambly shows six photographs of living natives from the island and concludes that they show "the presence of both Negroid and Australian traits, but . . . nothing of the Polynesian physiognomy." With this statement, and a brief reference to the geographical position of the Island, he turns to a consideration of the skulls.

Morphologically, male skulls are characterized by size, weight, ruggedness, a high vault, massive brow ridges, a tendency to an occipital

torus, and large mastoids. The orbits are rectangular, with thick margins. Interorbital diameter is wide, nasal root is depressed. The palate is deep, short, broad, with a horse-shoe shape. Alveolar prognathism is marked, and there are deep submalar depressions. Malars are thick, and bizygomatic width is marked. Upper facial height is reduced. Female skulls show much less ruggedness; brow ridges and mastoids are smaller; the occipital torus is reduced or absent. Orbits are rounder, with thinner margins.

Morphometrically these sex differences are substantiated, and here Hambly includes New Guinea (124 ♂, 70 ♀) and New Britain (163 ♂, 43 ♀) crania as well. Using a sex ratio (male dimension $\times$ 100 female dimension) he finds that "out of 94 sex comparisons of linear measurements 92 male values are in excess of female values." For indices, however, the situation is reversed, for "out of 38 indices, 26 are a little higher for females." In their entirety, Hambly concludes that only measurements differ significantly, when he states "that 95 sex ratios for size have as average of 1.059, whereas the sex ratios for 51 indices and angles are so close to unity that the average value of the ratio is 0.993. For size measurements the average sex difference is about 5.9%, but for indices and angles the sex difference is only 0.7%." Hambly also tests sex differences by $\triangle P_{\triangle}$ and of 40 values so recorded for indices and angles he finds that 34 are "not significant." The C.V. is also used, with the conclusion "that coefficients of variation show a marked racial uniformity in their size and range, but that males of each racial group, when compared with females of the same group, have the higher variability for a greater number of traits."

The age distribution of Melanesian skulls is reported on, based on endocranial suture closure. Hambly used his pooled series of 212 ♂ and 102 ♀ and Krause's series of 158 ♂ and 58 ♀. When these series are combined the age-distribution is as follows: 36.7% of ♂ and 66.2% of ♀ are between 20–30 years; 30.5% of ♂ and 21.9% of ♀ are between 30–40 years; 32.7% of ♂ and 11.9% of ♀ are between 40–50+ years.

Hambly offers some useful data on cranial capacity determinations. On eleven New Guinea skulls measured with no. 8 shot (Dorsey) and mustard seed (Hambly) the average cm^3 was 1336.4 ($\pm$ 27.2) and 1266.8 ($\pm$ 24.5), respectively. Using water determinations on a crâne étalon he found that no. 8 shot gave an average 5.4% too high, fine white sand of specific gravity 1.425 gave an average of 8.4% too high, while closely packed fine mustard seed agreed satisfactorily with the water determination. The Isserlis formula proved satisfactory: $C = .0003849 \times BLH + 96 \pm 65/\sqrt{N}$.

The real "meat" of the report is in the application of $\triangle P_{\triangle}$ to the Ambrym, New Guinea, and New Britain skull series. Hambly states that "the closest resemblance exists between skulls of Ambrym and New Britain . . . Out of 45 traits compared, 38 are so close that the average measurements show no significant difference." When Ambrym and New Guinea skulls were compared it was found that twenty-two out of forty-five traits showed no significant difference. With respect to the three Melansian series Hambly has this to say: "Basing my conjecture on inspection of (these skulls) I surmise that the New Guinea series bears a close resemblance to both Negroid and Australian series, but more particularly to the former. On the other hand, the skulls of Ambrym and New Britain are predominantly Australoid, if one may judge by general appearance."

The report now turns to a comparison of Melanesian skulls with "pooled" Polynesian (172 ♂), Africas (55 ♂ Wa Teita or East Africa), and Australian (103 ♂). The Ambrym skulls are close to Negroid, "since 31 average measurements show no significant difference from the corresponding averages for Negro skulls." They are also close to Australoid, since " there are 26 traits showing no significant difference." But there are seven "marked differences" from the Negro skull and only three such differences from the Australian skull. Hambly says, "Our visual impression that the Ambrym skulls are more Australoid prevails . . . " When the Ambrym skulls were compared with the Polynesian series only fourteen "not significant" differences were found. Hambly concludes that craniometrically "the marked differences between Negroes, Australians, and Melanesians are few . . . . Furthermore, the similarities in Negro and Polynesian (cranial) traits are by no means negligible . . . . It is by no means improbable that the explanation of all these cranial likenesses is to be found in the prehistorically remote contribution of Negro traits from a region that Sir Arthur Keith has referred to as the 'Black Belt' of southern Asia."

In two Appendices Hambly presents data on the mandible and teeth, and a very useful statistical tabulation of the S.D. in 48 ♂ and 15 ♀ cranial series. There is a very comprehensive Bibliography.

A piece of scientific research has to answer at least two questions. Are its conclusions logically drawn? Is it useful to others? In my opinion both of these questions receive an affirmative answer in Hambly's report. He constantly stresses the fact that the craniometric approach is but one of several. He also recognizes that, after all, every skull is first a human skull, second a *racial* skull. There are bound to be humanity-linked resemblances and identities. But there are also differences which are demonstrably significant. The report

is useful to those who will study it. I, for one, know more about Melanesian crania and possible inter- and intraracial affiliations than I did before I read this report. The author is to be congratulated, and the Chicago Natural History Museum is to be commended upon the appearance of the publication.

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LARGEST JEWISH POPULATION.— A fourth pervasive ethnic [sic] strain in the Soviet Union is the Jewish. At the outbreak of the Second World War approximately 3,100,000 Jews lived in the U.S.S.R., mainly in the western Republics, and comparatively few in Asia. With the new areas incorporated in the West in 1939 and 1940, the Soviet Union acquired about 2,200,000 more Jews, bringing the total to around 5,300,000. This gave the Soviet Republic a larger aggregate of Jews than even the United States, with its nearly 5,000,000. Because of the great number of Soviet Jews, perhaps above 1,500,000, slaughtered by the Nazis since 1941, the U.S.S.R. now ranks second to the U.S.A. in size of Jewish populations.— Corliss Lamont. *The peoples of the Soviet Union.* Harcurt, Brace and Co., N. Y., 1946.

AGING POPULATION OF THE UNITED STATES.— One of the most serious and challenging problems for the world of the next half-century will be the changing character of the population. In 1900 the percentage of the population of the United States over 65 years of age was 4.1. By 1940 the figure had risen to 6.8 and by 1980 will reach 14.4. In actual numbers this means that in 1940 there were nine million people over sixty-five and in 1890 there will be twenty-six million. The reason for the increase is two-fold: the normal increment of population in a growing nation approaching the plateau; and the extension of life expectancy. The life expectancy of the white male child at birth in 1901 was 48.23 years. In 1939 it was 62.60 years; an increase of almost 15 years. On the other hand, the expectancy of a white man aged 60 in 1901 was 14.35, while in 1939 it was 14.36; an increase of about 3 days. Much has been accomplished, but more waits to be done.— Robert A. Moore. The non-technical supplement. J. Geront., vol. 1, no. 1, pt. 2, 1946, p. 1.

NOTES

VIKING FUND MEDAL AND PRIZE

With the end of war-time restrictions and the prospect of increased income for the next fiscal year, the Board of Directors of the Viking Fund has voted to make available for the year 1947, and it is hoped annually thereafter, three gold medals together with three prizes of $1000 each to such scholars who have made the most significant contributions in the three basic divisions of anthropology, namely: Archaeology, Cultural Anthropology, and Physical Anthropology. These awards, to be known as the Viking Fund Medal and the Viking Fund Prize, are to be made by the representative anthropological associations, upon the advice of committees appointed by themselves, and will not be subject in any way to control or restrictions by the Fund. It is understood that no award will be made if, in the opinion of the associations, no contribution worthy of the award has been made in a given field during the course of the year. As the intention of the Board is to make the conditions of these awards as liberal as possible, it is their hope that the significance of a contribution will be evaluated either in terms of the results achieved through research, experiment, and discovery; or in terms of published literary, historical, and creative achievement. Recommendations for the Viking Fund Medal and Prize should be made by the Presidents of the representative associations to the Director of Research of the Fund before December 31, 1947.

The Committee of Award for the American Association of Physical Anthropologists will consist of the officers and Executive Committee of the Association, together with such other advisers as may be deemed necessary.

Physical Anthropology at Hunter College.— Prof. Elsie V. Steedman has called attention to the fact that the figures given earlier in this journal (n.s., vol. 2, 1944, p. 133) for the number of courses in physical anthropology taught at Hunter College of the City of New York and for the number of students registered therein are erroneous. During the school year in question (1941–42) six courses (not two) were given and a total of 1004 students (not 113) were registered. During the coming year Prof. Steedman hopes to better this mark.

GENERIC, SPECIFIC AND SUBSPECIFIC CHARACTERS IN HUMAN EVOLUTION

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Anthropologists all over the world have agreed that living mankind classified by Linnaeus as ''Homo sapiens'' represents a species in the taxonomic sense and that its main regional variations have to be considered as races or subspecies. In Linnaeus' time no other human form was known nor was there any indication that living mankind may ever have evolved from fossil forms differing morphologically from the living. Cuvier, the leading French morphologist, was so sure of the improbability of such an occurrence that he claimed, even half a century after Linnaeus: ''L'homme fossile n'existe pas.''

All this has changed radically. Today we know that man did have fossil forerunners which differed morphologically from the present human form and that these differences increase the farther back man can be traced. Theoretically we have to expect that the closer the general appearance of the preceding human forms approaches that of the simian stock, the more the forms depart from the modern type of man. No matter how ancient the fossil forms recovered so far may be, none has reached a stage which is not recognizable as human. In other words, they preserved certain ''human'' features even if other peculiarities show a closer resemblance to those usually found in apes. Since there is a continuous and gradual diminution of the first category of characters (''human'') and an increasing prevalence of the latter (''simian''), a change in the basic organization of the type cannot have taken place

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within the known range of vertical differentiation. This was one of the reasons why I concluded ('43) that the whole hominid group represents a single species when considered from the morphological point of view. Another argumentation was the fact that all racial variants of modern mankind are able to interbreed regardless of the degree of the morphological differences which separate them. There is no indication why the same might not have happened in the forerunners of modern mankind. On the contrary, the gradual evolving of modern man gives evidence that there must always have been an interchange between individuals or groups of individuals with differing morphological characters. The specimens of the Mount Carmel population of Palestine vary widely: they comprise Neanderthal types, those resembling more closely the Upper Paleolithic types of modern man, and those intermediate to both. No matter how these blends may be interpreted, their mere existence proves the unity of the human type which underlies all variations.

This statement has been challenged by R. R. Gates ('44). He does not question the main point, namely that Pithecanthropus-Sinanthropus, the Neanderthal man and recent man represent phases of a continuous evolutionary line, but he objects to my conclusions — he calls them "naive" — that all these forms represent only one species because of their genetic and morphological continuity. Gates censures me for not having consulted paleontologists who might have corrected my misconceptions. However, my mistake was apparently not exactly this neglect but my omitting to take into consideration earlier claims made by Gates himself. He wrote about the classification of man some years before ('37):

"It appears to me that we are justified in regarding Mongoloid, Australoid, Caucasoid, and Negroid types of man as representing separate species, each with various geographical races more or less clearly defined . . . The justification for this view will depend upon *how long these four specific types have been evolving* in separate geographic areas, more or less isolated from each other." (Italics mine.)

On the basis of this postulation the author distinguishes five "species" of living man: Homo australicus, Homo capensis (Bushman type), Home africanus (Negro), Homo mongolideus and Homo caucasicus. All other human races are considered subspecies of the five primary "species." Gates believes that the span of time a group has needed to differentiate and the duration of its isolation, but not the degree of their morphological differences, are the criteria decisive for their ranging in certain categories.

In the same issue of the Journal in which Gates published his principle of human classification, Dobzhansky ('44) arrived at conclusions directly opposite to Gates'. Dobzhansky agrees with me in considering living mankind as "a single polytypic species." With regard to fossil hominids, the author states:

> "On the basis of the available data there is no reason to suppose that more than a single hominid species has existed on any time level in the Pleistocene."

As this geological epoch covers the entire period of which we have, until now, evidence of the existence of hominids, all recognizable human fossils can be included in this "single species." In addition, G. G. Simpson's book, Tempo and mode of evolution ('44), and Zeuner's latest book, Dating the past ('46), may have shown Gates in the meantime how little paleontologists and geologists think of the time factor in this regard. As to the classification of the hominids, Simpson ('45) declares:

> "All specimens of fossil hominids that differ in any discernible way from Homo sapiens, and some that do not, have at one time or another been placed in different genera. Almost none of the anthropological "genera" has any zoological reason for being. All known hominids, recent and fossil, could well be placed in Homo. . . . Perhaps it would be better for the zoological taxonomists to set apart the family Hominidae and to exclude its nomenclature and classification from their studies."

Simpson refers only to genera in this quotation, but in an earlier paper ('43) he also discussed the species problem as

it appears to a modern paleontologist. Simpson distinguishes between three sorts of species: a morphological, a genetic and a taxonomic species.

"A morphological species is a group of individuals which resemble each other in most of their visible characters, sex for sex, and variety for variety, and such that adjacent local populations within the group differ only in variable characters that intergrate marginally.

"A genetic species is a group of organisms so constituted and so situated in nature that a hereditary character of any one of these organisms may be (possibly but not necessarily) transmitted to a descendant of any other.[1]

"A taxonomic species is an inference as to the most probably characters and limits of the morphological species from which a given series of specimens has been drawn."

Applying these definitions to man, living man certainly represents a genetic species because both conditions — constitution and situation in nature — permit the transmission of any hereditary character to any descendant. That fossil hominids also represent a genetic species can be inferred from the mere fact that some typically human features occur in all human types recovered so far, an occurrence which alone makes it possible to identify a given specimen as human. The repetition of those features through the entire human line proves that they have been transmitted from one generation to the next one, otherwise each type must have developed completely independent from any preceding one.

This brief review shows that Gates stands alone with his requirements for the definition of a human species. The taxonomists setting up rules for the application of zoological names have restricted their advice to the technique but wisely refrained from any directions as to the definition of categories. This is still left "to the experience and sound judgment" of the individual students, as Charles Darwin put it. In other words, classification is a completely subjective affair, depending entirely on personal evaluation of morphological differences. According to Gates' interpretation, the dif-

[1] This definition is taken over from modern geneticists (Dobzhansky).

ferences between the five main groups of modern man would be just as great as those between tiger and lion (Panthera tigris and Panthera leo), while the anthropologists never regarded them as greater than those between Siberian, Indian or Bali tigers. In any case, raising of generally acknowledged differences from the race (subspecific) level to the species level without really weighty ground is an artificial exaggeration of differences and a corresponding undervaluation of their congruities. Nobody has the authority to prevent anyone from splitting mankind into as many species or subspecies as they wish, but cogent reasons must be brought forward when the convention is disregarded. What Gates has produced cannot be accepted as satisfactory.

Therefore, we may ask whether there is any impartial gauge for the evaluation of grades in vertical or horizontal differentiations. Of course, each morphological unit will have its own gradation. The ideal would be to know the amount of the smallest possible difference and determine its grade in proportion to the amplitude of the whole scale of gradation characteristic of the type in question. Galton's biometrical school tried to reach a similar goal by measuring all measurable structures of the body and to calculate mathematical formulae for that purpose. The ''coefficient of racial likeness'' is the latest product of this endeavor. However, it is no more reliable than other methods. Since Camper the anthropologists have expressed differences by measurements and numbers so that physical anthropology has been, and in part still is, esteemed by outsiders as merely technical advice and tabulations of measurements obtained by the technic. Indeed, some textbooks on physical anthropology contain little more than directions for taking measurements. There were anthropologists who spent all their time in finding new measurements, indices and angles not applied before, hoping they might make distinctions more secure. But only a few took pains to test whether the demonstrated differences were of any diagnostic value. Everyone who is familiar with this problem is aware of the lot of useless ballast which is carried through the

literature and piles up further every day. The metric approach to our problem will meet with success only in those cases in which really characteristic differences can be defined by a few clear-cut measurements, not too complicated to be taken.

To refer to the braincase as an example: The cranial capacity gives a fair idea of its size. Its increase seems to be a good indicator of the progressive vertical differentiations of the hominids. The maximum values of the capacity ever reached by living anthropoids are 623 cm^3 for male gorilla and 580 cm^3 for female gorilla. The cranial capacity of the Australopithecinae, the only fossil anthropoid group of which fragments of the braincase are preserved, probably varied from 460 cm^3 to 650 cm^3 according to Broom ('46). The smallest cranial capacity of a fossil hominid found so far is that of Pithecanthropus erectus (Skull II) with a capacity of 775 cm^3. The smallest capacity of a Sinanthropus skull, 915 cm^3, is that of Skull E (Skull III). The remaining Sinanthropus skulls are larger, their capacities running up to 1225 cm^3. The capacity of the braincase of Homo soloensis varies from 1035 cm^3 to 1225 cm^3, the Neanderthalians from 1220 cm^3 to 1610 cm^3. When only normal adult skulls of modern man are taken into consideration, the variants range from 935 cm^3 (New Britain) to over 2000 cm^3 (endocast of Dean Swift's skull).[2] All this means that except for the Pithecanthropus Skull II, all fossil hominids lie within the capacity range of modern man. Therefore, the mere size of the braincase cannot be used as a criterion for the classification of hominids unless it is less than 900 cm^3. The average capacity of Sinanthropus, arrived at on the basis of the measurement of five skulls, is 1043 cm^3. This is clearly below the average of any living human racial group. The maximum value of the Sinanthropus skulls is, however, 1225 cm^3. Were only this skull known, and the capacity considered as decisive, Sinanthropus would have been ranged with the Neanderthalians. It is necessary to stress this point, for anthropologists dealing with fossil material and its classification are

[2] Collection of the Cenozoic Research Laboratory, Peiping, China.

often inclined to neglect the possible variability if there is no way of checking it.

The same sceptical attitude is justified in the appreciation of the linear dimensions of the braincase and their relation to each other. The range of the length-breadth index is the same in all hominids and anthropoids and so is the length-height index provided superstructures of the anthropoids which have no equivalents in the hominids are disregarded. When all principal measurements and indices are taken into account, no hiatus between the different hominid groups indicating a real break in the continuity of the general form can be noted; instead there is always an overlapping of neighboring types. As the essential transformation of the human skull is manifested by an expansion of the braincase while the number as well as the principal form of the individual bones which constitute the braincase remain unaltered, metrical characters can indicate a break only if very distant evolutionary phases are compared. Therefore, the conditions are the same as those presented in the different races of the domesticated dog in which large forms, such as the Irish wolfhound, are equivalent to the simian phase in human evolution and dwarf dogs such as the King Charles spaniel, to the modern human phase (Weidenreich, '41). This proves that within the entire hominid group, metrical differences of the braincase may at best indicate subspecific characters despite the fact that the development of this part of the skeleton is the most conspicuous vertical differentiation. It is needless to stress that this is even truer for the horizontal differentiations of the hominids, particularly of those of living mankind.

The lower jaw may serve as another example. Compared with the lower jaws of the anthropoids the human mandible has undergone a shortening in length concomitant to the reduction of the length (depth) of the face. Expressed in figures this means that the length-breadth index of the mandible $\left(\frac{\text{length} \times 100}{\text{breadth}}\right)$ is below 100 in all cases of modern man (breadth exceeding length) while it is above this mark in anthropoids (length exceeding breadth). The variations of

the human index figures are irrelevant. They have not even subspecific value because no racial group whatever differs distinctly from other groups in the amplitude of the range. Schulz ('33) noted the range of variants in seven different racial groups as shown in table 1.

The list reveals that an index above 100 which represents a primitive character can occur in such widely separated races as Negro and "Württembergians," while the most advanced forms (index farthest below 100) is found in Formosians, ancient Egyptians and again "Württembergians."

TABLE 1

Length-breadth index of the mandible after Schulz, '33.

RACIAL GROUPS	MINIMUM-MAXIMUM VALUES	AVERAGE
Europeans:		
Württembergian	75.6–106.2	89.7
Mongolians:		
Formosian	74.8– 95.4	84.0
Amerindian	79.7– 95.2	87.8
Melanesians:		
Baining	77.8– 97.2	87.9
Negroes:		
Without special definition	79.7–106.7	91.0
Ancient Egyptians	76.1– 97.2	86.6

The mandibular angle (angle of the ramus at the gonion) shows a wide range of variations in all the main races (table 2). However, the size of this angle depends to a certain extent on age, sex and conditions of the dentition so that any statistics without reference to these factors are of dubious value. But it seems that European races have in general a more obtuse angle, i.e., a less steep ramus, than non-European races if the judgment is based on Schulz's figures in table 2. Yet — and this is characteristic of most of such measurements — Kieffer ('08) did not find such a wide range of variability in the Southwest German population as Schulz.

According to Kieffer, the angle varied from 107°–135° for males between 17 and 90 years of age, and from 111°–137° for females in the same age groups.

The proportion of the ramus as expressed by its height-breadth index is of special interest in this discussing of valuing metric differences. The figures listed in table 3 show that

TABLE 2

Angle of the mandible (at the gonion). After Schulz, '33.

RACIAL GROUPS	MINIMUM-MAXIMUM VALUES	AVERAGE
Europeans:		
Württembergian	115–145	126
Mongolians:		
Formosian	105–131	120
Amerindian	106–133	122
Melanesians:		
Baining	100–132	116
Negroes:		
Without special definition	106–132	117
Ancient Egyptians	110–133	122

TABLE 3

Length-breadth index of the ramus of the mandible after Schulz, '33, and Fürst and Hansen.

RACIAL GROUPS	MINIMUM-MAXIMUM VALUES	AVERAGE
Europeans:		
Württembergian	38 –60	49.5
Mongolians:		
Formosian	49.2–68.9	56.4
Amerindian	47.6–66.7	56.2
Eskimo (Greenland)	48.8–82.2	65.2
Melanesians:		
Baining	48.4–70.2	57.6
Negroes	46.0–81.4	62.1
Ancient Egyptians	47.7–75.5	58.2

there is a difference between Negro and Eskimo and other races. High indices, i.e., a broad ramus, is much more frequent in the first two racial groups than in others. We will return to this question below.

In considering the result of all the possible measurements of the mandible of which three examples have been given, Schulz arrived at the following conclusions:

> "One has to agree with Rasche and other earlier authors that the mandible is very variable in all its parts. The ranges of the variabilities of the individual measurements are very great in almost every racial group and overlap each other more or less."

This is true not only of modern mankind but also for the fossil hominids when only the usual routine measurements are applied. There is no clear group difference between the Neanderthalians and modern man. Some years ago van den Broek ('32) showed that even the dimensions of the Heidelberg mandible which won special fame for its size and clumsiness do not surpass the range of modern man or even that of the "entire hominid family" as Werth once claimed. Van den Broek came across the mandible of a Malayan woman which matches the Heidelberg jaw in its main dimensions. The ramus of this fossil specimen, in particular, has been considered as unique as far as the proportion between breadth and length is concerned. This index is 77.9, that is less than the index found in modern Negro (cf. table 3) and Eskimo, the latter reaching up to 82.2.

When non-metrical peculiarities are subjected to similar scrutiny the results are the same. It suffices to quote Schulz again. With regard to racial differences of the mandible he stated:

> "The morphological characters almost never exhibit a clear absence in one race nor are they found exclusively in another, nor was there an obvious difference in the degree of their development."

Schulz assigns the following reason for his failure to define any metrical or non-metrical racial differences:

"The racial groups represent no pure races and, therefore, no sharp separation between the different groups can be expected, but only a prevalence of certain characteristics."

This admission is remarkable because the material handled by Schulz consisted of such widely differing racial groups as Whites from Central Europe, Negroes, Melanesians, Amerindians and Asiatic Mongolians. By using the term "pure races" Schulz wants to stress that each of the groups he studied includes elements which may also be found in any other "race" and renders, therefore, more precise distinctions difficult. Although Schulz' statement refers only to the mandible, it can be extended to any other part of the skeleton. Braincase and facial skeletal parts may reveal, in some cases, metric and non-metric peculiarities which might indicate features considered characteristic of other races, but such a happening does not imply that all individuals or even the greater proportion of individuals attributed to those racial groups must necessarily display the same features or that those features may not be met in individuals who are usually attributed to quite different racial groups.

To elaborate further on what I have in mind: Schulz dealt only with skeletal parts but it can safely be presumed that the mandibles of the Württembergians and those of the Melanesians, which are not distinguishable from one another, were bones of individuals whose outward appearances displayed all the peculiarities of their respective "races." In other words, racial differences which are very impressive when regarded from the outside, become less distinct beneath the skin. This holds good not only for man. A lion and tiger, whose hides have been stripped off, are hardly distinguishable from one another. As far as the viscera or the muscular, vascular or nervous systems are concerned, racial differences in man are restricted to frequencies of the occurrence of certain "anomalies," i.e., deviations from the general acknowledged standard. This standard is based on frequencies found in the white populations. The soft parts especially seem to have preserved "primitive" character-

istics. Testut who dealt with these anomalies of the muscular system claims that all are "atavisms."

In an earlier paper ('41) I attempted to group morphological characters in three categories. Starting from the conditions in man I distinguished (1) fundamental characters, or those of the first order, (2) special characters, or those of the second order, and (3) secondary characters, or those of the third order. As fundamental characters I defined those criteria which are typical of the entire group — in our case the hominids — and permit, therefore, its distinction from neighboring groups — in our case the anthropoids. Special characters are those whose developments signify the specification of the first category. These can greatly change the general and special appearance of the type without altering its fundamental characteristics. All those peculiarities which are "accidental" in the sense that they are not necessarily combined with, or dependent on the fundamental type or any of its specializations, are secondary characters. All that characterizes man as such are characters of the first order: for example, dwarfism or gigantism and all features whose peculiar development depends on these specifications are characters of the second order. Those of the third order comprise differences in complexion, pelage, hair texture or physiognomical traits which can occur in any specification. In the hominids the fundamental character has remained unaltered as far as man can be traced back into the past. The hominids represent one species and all their vertical and horizontal specifications, regardless whether the characters involved belong to the second or third category, are subspecies. As has been indicated above, a mandible with the same metric or non-metric features can belong to an individual with any fair or dark complexion, or straight, waved or kinky hair. In the case of the various dog races, hair color and hair texture vary without showing any preference for a certain group no matter whether large or dwarf races are concerned.

Although G. G. Simpson ('44) finds such a classification of characters useful, he considers the assumption on which it

is based "demonstrably false" because the same kind of characters may distinguish "good" families or genera in some cases, in other cases species or subspecies. He claims that characters of the third order are not qualitatively different from those of the first order, they may regularly become those of the first order. I do not know of any mammalian order in which differences in hair color or hair structure alone have ever been used for the distinction of families, genera and species. And even if it has been done, it would have been arbitrary and without justification regarding the morphological differences which generally indicate higher categories. In the same paper ('41) I distinguished between correlated and non-correlated characters, a distinction Simpson set aside considering such a distinction irrelevant. However, phylogenetic evolution of man certainly consists of strictly correlated changes of his organization such as can also be found in other classes and orders of the animal kingdom. To what extent this type of evolution is a general biological phenomenon is not a subject of our discussion.

To revert to the point from which we started: a specific difference in a skeletal part of man does not necessarily indicate alteration of the organization of the type. However, a generic difference which affects the organization itself must be traceable to a different evolutionary line. So far the existence of those lines have not been demonstrated. When the mandible is again taken as an example, no single feature, no matter in which racial group it may appear, is incompatible with the general modern human mandibular pattern. When, however, this general pattern is compared with that of early man (Archanthropines or Paleoanthropines — Weidenreich, '46), one essential difference at once strikes the eye. It is neither the size nor the proportions of body or ramus, nor details of the surfaces, but it is the configuration of the chin. The absence of a mentum osseum and a trigonum mentale is typical of early hominids while the presence of these peculiarities characterizes the modern human type. The conditions of the outside of the chin region correspond to certain

differentiations on the inner side. The chinless stage coincides with the development of a pit (fossa m. genioglossi) and a small spurlike elevation below this depression; the chin stage coincides with the planing of the depression and the appearance of a y-shaped spinous outgrowth below. The chinless condition is characteristic of all the monkeys and apes. Nevertheless, even in its "simian stage" the human form differs from the apes by showing a special human stamp.

The chin and the affiliated structures are a relatively late product of human differentiation. Their appearance, however, is not an isolated phenomenon but one of a long drawn-out process which is part of the transformation of the skull. The transformation is characterized by expansion of the braincase and increasing reduction of the facial skeleton in size and massiveness. There is a close correlation between the protrusion of the gnathion region, the development of the mental spine, the recession of the alveolar portion, the reduction of roots and crowns of the front teeth, the projection of the anterior nasal spine and many other details of the same kind. The correlation is evident when a series of succeeding evolutionary phases are compared with each other. But it is typical of a "progressive evolution" such as that of man obviously is, that individual features of correlated feature groups may appear independent of others in certain cases. The crowns of the front teeth of the Heidelberg jaw are not clearly larger than those of modern man; only their roots are, and there is, in accordance with the latter peculiarity, neither a recession of the alveolar portion nor a chin. The dawn of a chin is already manifest in the Sinanthropus mandible, and also in some of the Krapina jaws, but the first shows an already well developed mental spine yet not the latter.

The assumption of the upright posture and the characteristic alteration of the entire human skeleton in connection with that new acquisition is a still more convincing example of transformations correlated in principle but not synchronous in their appearance. The anatomical construction of foot and

hand admit of no doubt that man was originally a climbing creature. At which phase of evolution he abandoned this kind of locomotion and instead stood and walked on the ground is unknown and does not matter for the moment. As far as there is evidence by fossil data man was erect. His limb bones do not display any fundamental difference compared with bones of modern man. However, the skull in all its constituents, braincase, face and dentition, behaves quite differently. Neither the skulls of the Archanthropines nor those of the Paleoanthropines are fully adjusted to the requirements of the upright posture. The gradual "rolling up" of the braincase as it is expressed by the increasing deflection and shortening of the skull base, the development of the vertex "hump" of the brain, and the trend toward brachycephalization together with increasing orthognathous conditions of the jaws, indicate that the process of adjustment is not yet finished but still goes on even in mankind of today (Weidenreich, '46). This proves the long lasting effect of correlative factors in human evolution.

Such a distinction of characters as I have in mind may have little interest or value for those taxonomists who look only for differences which are useful for the establishment of "good" species or similar categories and do not care whether they have any bearing on the general organization of the type concerned. But it is not irrelevant if the aim of distinction is not the establishing of a classified inventory of specimens but serves as a means to elucidate and explain phylogenetic evolution. This is a great advantage morphologists have over geneticists whose methods do not permit them to distinguish forms, recent or fossil, with the same degree of certitude.

Whether we consider the changing characters as generic or specific is irrelevant. The point which counts is whether they represent peculiarities of one and the same fundamental organization. Wherever lines may be drawn with the intention of separating genera or species, it is evidently an arbitrary act. Time is certainly not a decisive factor as Gates believes. If this were true the skull of man, which became

differentiated much later than his trunk and his limbs, as shown above, would have to be attributed to another category than the limbs. So we arrive at the old but never settled questions: How have the manifold characters which determine a type to be weighed in the system of classification? Which one decides the issue? Do qualities of the teeth count more than those of the bones of the jaws, or those of the skull more than those of the limbs? In the case of man, the answer does not seem to be too difficult. His phylogenetic evolution went in the direction of the special development of the brain. Therefore, characters of the brain or the braincase should have priority over other parts of the body. This problem has not been sufficiently discussed either by taxonomists or geneticists; apparently because there are many evolutionary lines in which no special direction is recognizable. In those cases the essential characters remain unaltered in time or, if they change, the change is restricted to certain organs and does not affect the organization of the type as a whole.

It is a well-known fact that some racial groups are distinguishable by the abundance of so-called primitive characters of the skeleton, particularly of the skull and the physiognomy. Tasmanians, Australians, and Melanesians show them to a very high degree. However, they are not confined to these groups but may occur in any of the main racial divisions of modern mankind and their subgroups. If primitives are found in the white population, they have usually been defined as "Cro-Magnon" types because they are regarded as the direct descendants of that Upper Paleolithic group. Primitive types are very common among the Amerindians; they are spread all over the Americas from Alaska and Labrador in the north, to Tierra del Fuego in the south. Interspersed among a great many different Indian tribes in varying frequency, they pass as Australoids or Melanesoids in the literature. Their occurrence has been considered evidence of an early migration of Australian people to the New World. However, similar primitive types are also found among Negroes or Asiatic Mongolians; the Ainu are

a typical example of their occasional massing in certain regions and certain racial groups. The main morphological features of the skull of these types are almost the same everywhere: they are heaviness, massiveness, marked superstructures and related formations, pronounced dolichocephaly, and nearly rectangular frame of the orbit, orthognathism or only a slight degree of prognathism. Other features of braincase and facial skeleton vary and show more distinct tendencies toward physiognomic differentiations.

There is little doubt that these primitives have maintained characteristics of the penultimate evolutionary phase of man which is almost identical with that of modern man but has been distinguished from the latter under the special tabulation "Homo sapiens fossilis." The type and the way in which it is distributed over living mankind is a striking example of the manner in which antiquated evolutionary phases survive and finally disappear. A more precise knowledge of their distribution and statistics of their frequency in the different populations in which they occur would be a splendid contribution to our knowledge of the origin and development of modern races. It would be of the greatest interest to identify them among the living and determine their exterior with regard to special racial characters, e.g., to what extent do they differ in complexion, hair texture or phyiognomical traits from the mass of the population among whom they live. The "Cro-Magnons" of today, Ainus, Tasmanians, Australians and Papuans suggest that any exterior may be compatible with the morphological type they represent. Primitive characters play an important role in all human races. Phylogenetically considered, all mankind is still advancing although the tempo may differ in different racial groups. Therefore, the concept of primitive is purely relative.

Whatever the answer to these questions may be it is obvious that very little is known of the real nature of the racial characters of modern man despite the wealth of literature produced during all these years by competent, and still more incompetent, authors. Also the furtherance by genetics was

more an elucidation of the technic of the heredity of existing racial characters than an explanation of their development and relations. In any case, it becomes more and more clear that all the differences between all construeable racial groups never implicate the fundamental character of man as such. Only in man's vertical differentiations are deeper reaching changes to be found. The latest discernible ones, such as the development of the chin and vertex hump of the brain represent only the final evolution of a long "rectilinear progression" which involved the skull when the remaining skeletal parts had already come to rest. Provided that it is justified to deem those "local" achievements as indicative, the appearance of chin and hump could be interpreted as the birth of a new human form. But even so it would not mean a generic or specific change of the old type.

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BIBLIOGRAPHICAL NOTE ON ANTONIO SANTIANA.— During 1945 the Editor received a manuscript from Dr. Antonio Santiana of the Central University of Quito, Ecuador, on "Los grupos sanguíneos en los Indios del Ecuador." Since this represented the first serological work done in this area, the manuscript was accepted. Dr. William C. Boyd kindly furnished a translation. Publication was scheduled for September. Then, after proof had been read and a press release prepared, along came a reprint of the same article in Spanish from Notas del Museo de La Plata (tomo 9, antrop. no. 30, 1944, pp. 431–438). Thereupon, the article was withdrawn from the Journal on account of the rule against duplicate and prior publication (see inside back cover).

In the September, 1946, issue of the Journal appears an article by Dr. A. Lipschutz et al. on "The bearing of ethnic and genetic conditions on the blood groups of three Fuegian tribes." The Editor was authorized by the Association at its Cleveland meeting to obtain this for publication. Footnote 5 explains that Dr. Santiana was a guest of the Mission and in that capacity made the blood group determinations on the Yámana and Alakaluf.

After the receipt of the manuscript Dr. Lipschutz wrote to the Editor as follows:

> As to Dr. Santiana . . . who was my personal guest in this Chilean Mission, I must unfortunately tell you frankly that I cannot take any responsibility for his future procedure. On the 22nd of February he agreed with us in a special meeting of all six scientific members held in Punta Arenas, that the Chief of the Mission would give out information about the scientific results of our Mission and that these communications would be made in the name of the workers who took part in the different aspects of the investigation. He agreed also that all the papers to be published by individual members should be sent first for revision to me. To my great regret I learned yesterday about a leaflet which he circulated on the 12th of March before leaving for Ecuador, and in which he declares, contrary to the former agreement, that he will write independently about the work in which he took part. Also, in this leaflet he ridicules the work of other members of the Mission and accuses me of intending to rob him of his scientific results.

Dr. Lipschutz' fears were well founded, because during the summer Dr. Santiana published "Los Fueguinos; sus grupos sanguíneos" (Quito, Imp. de la Univ., 1946, 76 pp). Since Dr. Santiana did not have access to all the material on the Fuegians, his unofficial report is less useful than the one in the Journal. However, he supplies data on a large sample of the mixed population of Puerto Montt and Punta Arenas.

CLENCHED FINGERS AN HEREDITARY TRAIT.— I had decided to make contour drawings of the hands [of the Oajana Indians of Dutch Guiana] in order to take some measurements. When I chose the captain of the tribe as the first one to be studied I observed that the fingers of his right hand were clenched and could not be stretched. At first I attributed this to some disease like rheumatism but when another Indian showed the same phenomenon on both hands it became possible that the clenched fingers were a hereditary character. The two men showing the character were somewhat related, but the whole tribe of Oajana Indians, less than 400 in number when counted by Schmidt ('42), were a population in which inbreeding had been practiced at least for some generations. Under the present circumstances I had no opportunity to decide whether the malformation of the hands was due to disease or to genetic variability, but the latter point of view is strengthened by a piece of folklore of the Indians of the Guianas mentioned by Roth ('15).

Roth published the following story as circulating among the Indians. A man shot a baboon [sic], a monkey of the genus Mycetes, cut off its tail, roasted it and ate it. The remainder of the carcass was put away to get smoke dried during the night. Next morning the carcass was gone but there was a woman lying in his hammock. The man had his suspicions as to her origin aroused on noticing that her fingers were naturally clenched and that with one hand she was continually trying to keep extended the fingers of the other. Some years later during a feast when every one was drunk the woman confessed to be of monkey origin.

A footnote by Roth explains that when a monkey is smoked the digits, owing to muscular contraction, invariably become strongly clenched. Obviously the man in the story is said to have eaten the tail of the monkey in order to promote the metamorphosis to human form.

Clenched fingers, therefore, seem to be such a common phenomenon among Guiana Indians that a popular explanation was wanted. It may be a hereditary trait.— A. B. Droogleever Fortuyn. Some data on the physical anthropology of Oajana Indians. K. Ver. Indisch Inst., Amsterdam, Med. 69, Afd. Volk. no. 22, 1946, 24 pp.

THE ASSESSMENT OF SOMATIC ANDROGYNY

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SIX FIGURES

Among the many studies of body build there has been little systematic work done on the degree of sexual variation of form between and within the sexes, although several recent studies have indicated the probable usefulness of such a classification. One of the most complete descriptions of these variations is by Draper ('41, '44), who has written a provocative article on "The Mosaic of Androgyny," in which he describes the typical masculine and the typical feminine build. He also gives, for each sex, a series of photographs of adults exhibiting varying degrees of masculinity and femininity of form; and he further postulates relationships between these variations and certain disease diatheses. Sheldon ('40), in classifying young men, describes feminine characteristics as variants which are to a certain extent independent of the basic body types in his system.

If sex differentiation in build varies more or less independently of other hereditary and environmental factors, it should be clinically useful to rate these aspects of body form in such a way as to facilitate comparisons between the androgynic variables and other characteristics of physique and personality. An approach to this has been made, for young men, by Seltzer and others on the Grant Study staff (Heath, '45; Hooton, '45). They have followed the leads of Draper and Sheldon, and classified the "masculine component" in young men (mostly Harvard sophomores) into strong, mod-

erate, weak, and very weak. However, their grouping puts only about 10% of the cases into the moderate through very weak classes, leaving 90% in the "strong masculine component" group without being further differentiated. In comparison with other aspects of their data they have found that young men deficient in masculine component characteristically differ in some personality traits and in physical fitness, from the bulk of "strong masculine component" men.

A somewhat different approach to the study of sex differences in build was recently reported as part of a study by Bullen and Hardy ('46). They rated 175 women, from photographs, according to Sheldon's body types. Although sex differences in the frequencies of endomorphs, ectomorphs, and mesomorphs are in the expected direction (i.e., more of the first two and fewer of the last) they are surprisingly small. However, as no direct comparisons of the sexes were made, women falling into these categories are not necessarily similar in build to the men so classified. For example, many women rated by them as mesomorphs would seem so by comparison with other women, but would probably not be so rated if compared with men on identical standards: a person is considered to be muscular or not in comparison to others in the group, and his rating of muscularity thus depends on the muscularity of the other members of the group.

For the purpose of assessing androgyny, it seems to us important that relatively objective criteria be set up. For such body characters which cannot be measured on an absolute scale, one should employ accurately descriptive terms based on observations of a normal array of physiques of both sexes. Objectivity can be further established by the use of pictorial standards representing classes set up for the characters to be rated.

In previous papers, we (Bayer, '39, '40; Bayley, '43) have been concerned with various aspects of build in relation to sexual maturation and differentiation. Our studies have dealt primarily with skeletal proportions as the basic criteria of status. Where coverings and contours of the body have been

considered, they have been referred to only as confirming or disputing the evidence of the skeletal measurements. In this paper, however, these less tangible phenomena of body and surface molding are a matter of primary concern.

The present study reports an attempt to systematize the androgynic variants in a group of boys and girls who have just approximated physical maturity. Work with both sexes has made it possible to observe in detail which characteristics are related to sex differences and which characteristics vary without regard to sex. It has the added advantage of taking practical cognizance of the accepted biological fact that every individual is a composite of both masculine and feminine endowments, and that the only mutually exclusive sex element is the gamete.

In general, there are four factors which appear to be important within the realm of sexual differentiation: its direction, its degree, its tempo, and the amount of incongruity in the same organism. When these factors were considered by Bayer ('40) in studying the builds of women and adolescent girls, the following classifications were developed: feminine, hypofeminine, hyperfeminine, virile, and mixed (or disharmonious). Considering these same factors as applied expressly to manifestations of body form and covering, this classification has been largely confirmed for the female figure, and further amplified and related to the male figure. It is possible, of course, to choose different factors as the critical basis of classification. Given individuals will then fall into somewhat different groups, depending on the basic criterion used. But whatever the device, the same dynamic concept appears to hold.

The material here reported consists primarily of photographs of nude subjects approximately 17.5 years of age (Jones, '39). Front, side and rear view pictures were taken from a standard distance, under standard lighting conditions with a camera built around a wide-angle lens which gives a minimum amount of distortion. Additional data include

anthropometric measurements, strength scores and skeletal age assessments from x-rays, for these same subjects.

Much of our exploratory work will not be given in detail. It was done on a small "pilot" group of sixteen girls and twenty boys (Bayley and Jones, '41). The purpose of this preliminary study was to identify items which were most clearly different in the two sexes. This was done by covering parts of the photographs so that only a section of the body was exposed, e.g., hips, or waist line, or legs, and then rating these isolated segments. Often this device concealed the sex as well as the identity of the subjects. Various systems of ratings and combinations of ratings were tried. Sometimes the pictures were arrayed in rank order; sometimes they were placed in "matched stacks," i.e., cases with similar contours were put together. Those items in which there were high agreement between raters and consistent differences between sexes were selected for further study and refinement. Some attributes commonly thought to vary with sex, for instance shoulder slope, showed in fact no such relation.

Eight items were eventually selected to compose a set of ratings giving the androgynic pattern of body form. These ratings can be made most accurately from the rear-view photographs and are true variants of form regardless of sex. Where photographs are not available, the clinician can record his ratings directly from observations on the patient. The ratings all show bi-modal distributions with most boys rated at the normal masculine and most girls at the normal feminine position, and with varying amounts of overlapping of the sexes. The bi-modal distributions may be taken as one criterion of validity of the items used, because they do show marked sex differences, while within each sex there is variation in the extent to which a character is manifested.

The ratings, which are described in detail below, may be used to draw a profile which will give a general impression of the pattern of a subject's androgyny, as well as the congruity or disharmony of his build. However, the individual item ratings are not highly reliable, and profile variations

must be interpreted with caution. The androgynic score, the sum of the eight ratings, is more reliable, and indicates the degree and direction of deviation from the sex norm.

Breast and penis size, the pattern of body and facial hair, and the trunk breadth index are other elements which enter usefully into a consideration of sex in body form.

DESCRIPTION OF CHARACTERISTIC SEX DIFFERENCES TO BE FOUND IN YOUNG ADULTS (C.A. ABOUT 17 TO 18 YEARS)

The concept of rating items on a single continuum from extreme masculine to extreme feminine proved to be an over-simplification, because of the complex factors affecting the intermediate, between-sex area. However, the typical and extreme characteristics for each sex fit very well into the general shape of a normal frequency distribution. Furthermore, if the between-sex characters are grouped together, then an array of ratings including both sexes falls into a symmetrical bi-modal curve. On the five-point scale used here "2" represents the characteristic masculine and "4" the characteristic feminine. A ratings of "1" is extremely masculine, "5" extremely feminine. "Three" represents an intermediate rating which must be further subdivided according to degree and kind of differentiation.

In the process of changing from the neutral build of childhood (fig. 1) to the mature form (fig. 2), growth in the male is greater in certain aspects, in the female in others. Therefore, for each sex some characters maintain their undifferentiated form while for the other sex the character changes: for instance, the male broadens at the shoulder, while the female shoulder remains relatively unchanged; the female broadens at the hips while the male hip remains unchanged. But individuals do not invariably follow the patterns of their sex. Their processes of differentiation are characteristically of two kinds: (a) differentiation in degree, from the neutral childhood build toward the build characteristics of the same sex; and (b) differentiation toward the mature form of the opposite sex as well as toward the same sex, i.e., bisexual

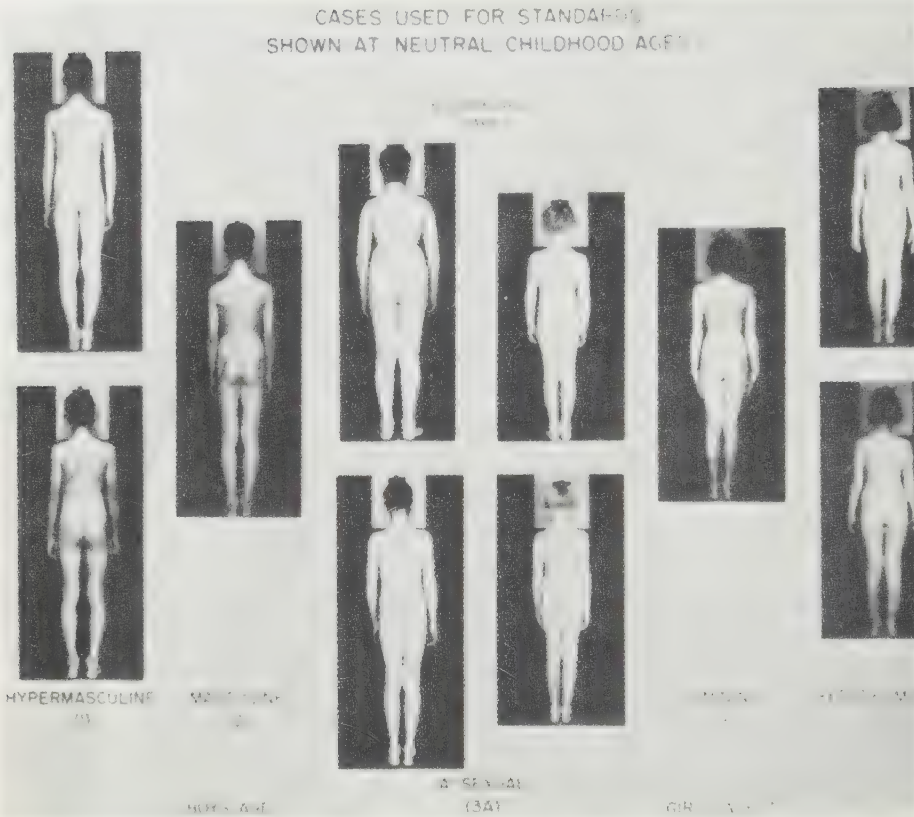

Figure 1

development. The bisexual development may also vary in degree of differentiation. Persons whose builds are not characteristic of their own sex may therefore remain either undifferentiated, or asexual; or else they may develop both masculine and feminine, or bisexual, characters. For instance, a thin, spindly lower leg would be rated "3" because it has neither masculine muscle nor feminine fat. However, a leg strongly molded by development of both fat and muscle would receive a similar "3" rating since it would also lie between the typical sex forms, sharing characteristics of each. It is thus important in interpreting the total build picture,

properly to evaluate "3" ratings as asexual "a" or bisexual "b" whenever this distinction can be made. (This is usually possible for items, A, B, C, and H, described below.) For each rating the typical undifferentiated preadolescent state is sketched, followed by notes on the masculine and feminine forms. The bisexual forms are not separately described, as they are merely characterized by evidence of differentiation in the direction of both masculine and feminine attributes.

From the above discussion it is apparent that the patterns of sexual differentiation can be visualized as a sort of fan, where masculine and feminine characteristics develop from an undifferentiated stem, and wherein bisexual and asexual

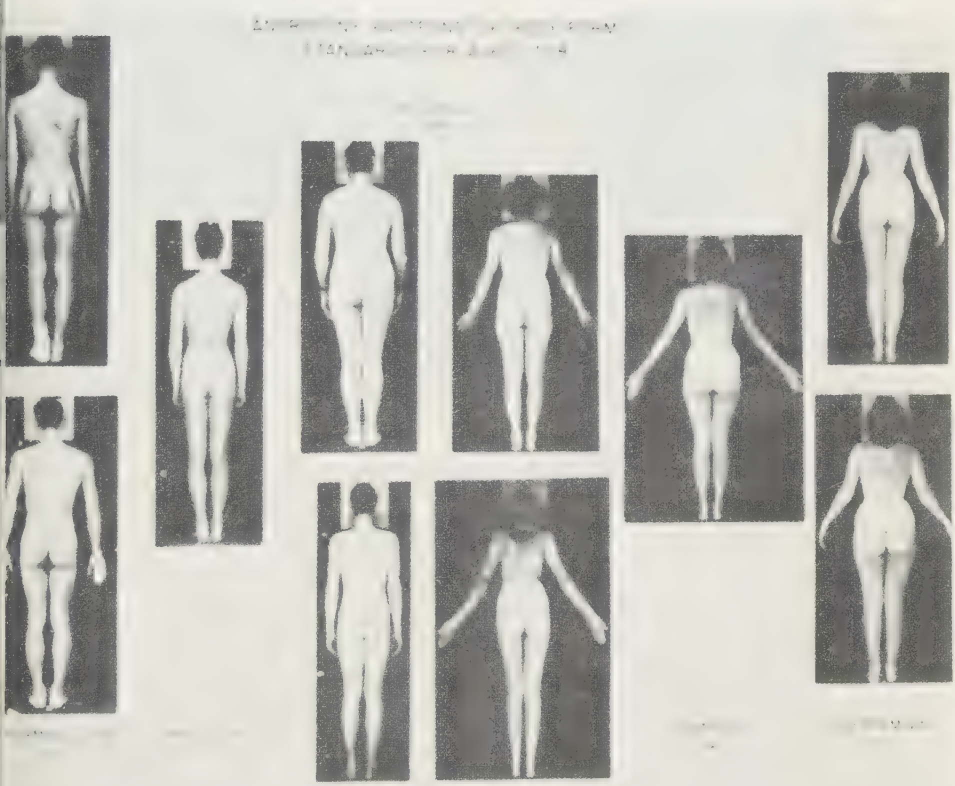

Figure 2

characters fall in areas between the normal variants, as illustrated in figure 3.

In adolescents whose growth is not completed, it is impossible to determine whether relatively undifferentiated individuals are slow in maturing or whether their processes of differentiation are arrested so that they will never achieve the builds characteristic of their sex. For this reason the ratings on still-growing children can be applied in only a

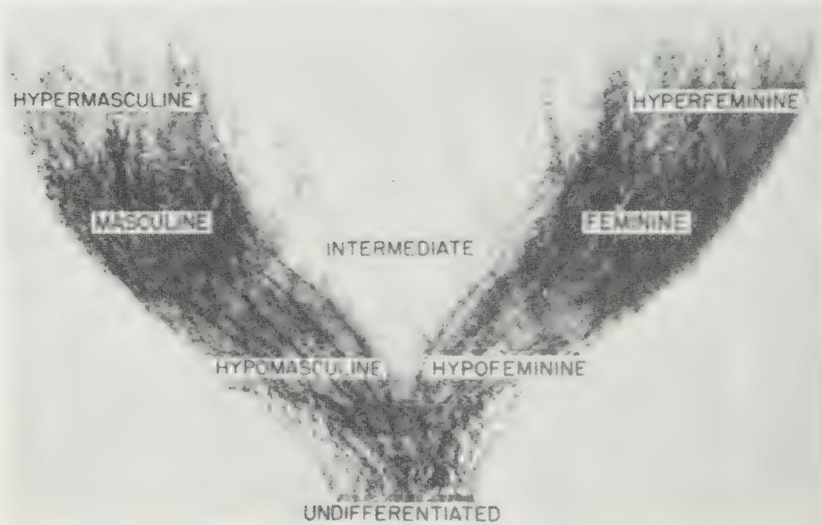

Fig. 3 Diagram showing the degree and direction of sex variations in mature body form.

limited way, with reservations about predicting the mature builds of the undifferentiated cases.

As noted above, the use of the five-point rating scale on normal samples of young adults including approximately equal numbers of both sexes, results in a bi-modal distribution on each of the eight items rated from rear-view photographs. The modal points are at ratings "2" and "4", although a few characteristics of either sex may be rated beyond "3" in the region typical of the opposite sex. This is especially true of the leg pattern ratings.

DIRECTIONS FOR RATING

The directions are supplemented with photographs of cases representing each of the ratings (fig. 2). In order to illustrate all "1" and "5" ratings, more than one "extreme" case is presented, as no one case usually shows an extreme development of all characters. Although only one example is given for each of the intermediate types, this same condition holds for them: a person who is asexual or bisexual in all aspects of body form is very rare. The ratings actually given to the standard cases are shown in table 1. These ratings

TABLE 1

Ratings given to ten cases used as standards in figure 2.

CASES	RATINGS FOR STANDARDS									
	MH	MH'	M	MB	MA	FB	FA	F	FH	FH'
Items										
Surface modeling	1	1	2	3b	2.5	4	4	4	5	5
Shoulder girdle	1.5	1	2	3b	3a	3b	3a	4	5	4.5
Waist line	2	1	2	3b	3a	3b	3	4	5	5 —
Hip flare	2	1	2	2	2 —	3	3.5	4	5 —	5 +
Buttocks	1	2	2	4	3	3	3	4	4	5
Thigh form	1	2	2	3	2	3	3	4	4	5
Interspace (whole leg)	1	1.5	2	4	3	3	4	4	5	5
Muscle bulge (lower leg)	1	1	2	4	3a	3b	3a	4	5	4.5

should be referred to, in conjunction with the pictures, to aid in determining the correct ratings for specific body areas.

The chart (fig. 4), which may be used as an individual record form, gives abbreviated summaries of the descriptions, to facilitate ratings once the directions are understood. It is hoped that with these several devices fairly objective ratings can be made. The actual items to be rated are indicated by letters which correspond to letters on the chart. In general, the prejudice should be in favor of ratings "2" or "4" for the appropriate sex, unless there is an obvious indication otherwise. The purpose of this rating scale is to assess androgyny, rather than such variants of physique as Kretschmer's

ANDROGYNIC PATTERNS OF BODY FORM: RATING PROFILE

Bayley-Bayer Standards*

17–18 Year Norms

Name | Sex M F | Date | Age | Skeletal Age | Case Number

ITEM ("A" through "H" from rear-view photographs)	RATING: Hyper-masculine 1	Masculine 2	Intermediate, A-sexual, or Bi-sexual 3, 3a, 3b	Feminine 4	Hyper-femi[nine] 5
I. A **Surface modeling**	Exaggerated hardness of relief	Strong muscle molding Bone, vein and tendon prominences.	b Muscular and fat. / a Little muscle or fat.	Smooth and soft, with little muscle.	Very soft, fat, no m[uscle]
II **Trunk Contours** B Shoulder girdle	Massive	Appears wide, heavy and muscular	b. Muscular and fat. / a Narrow, "bony"	Slight, soft and narrow.	Frail, softly fat.
C Waist line	Marked torso narrowing to low waist may have minimal indentation.	Slight indentation due to narrowing of torso.	b. Broad hip and shoulder, little indentation. / a Slight symmetrical high concavity	Definite line accentuated by hip widening.	Marked indentatio[n]
D Hip flare	No widening	Slight widening of hips from waist.	Intermediate	Flares into wide hips laterally and posteriorly.	Marked flare.
E. Buttocks	Very flat.	Flat and angular	Intermediate.	Rounded and full.	Very broad and ro[unded]
III **Leg Patterns** F Thigh Form	Cylinder and/or bulging muscles.	Approaches cylinder Lateral outline convex	Intermediate.	Funnel, fat and rounded. Lateral outline concave.	Fat, wide-top funn[el]
G Interspace (whole leg)	Very open	Open center above and below knees	Intermediate	Closed center except small space below knees.	Thighs and knees t[ouch] feet apart.
H Muscle bulge (lower leg)	Strong bulge, no fat	Prominent inner bulge of gastrocnemius.	b Moderate muscle bulge. / a. No muscle bulge spindly	Slight inner bulge, shapely, smooth, outer curve.	Very little musc[le] smoothly round[ed] outer curve.
Supplementary Criteria J Penis size	1 Very / 1 5 Large	2 Average	2.5 Small / 3 Very		
K Breast size			3 Very / 3 5 Small	4 Average	4.5 Large / 5
L. Body hair density	1 Heavy on thighs, etc	2 Easily discernible	2 5 Sparse / (3) ○♂	○♀ Absent	
M Pubic pattern	Disperse / Acuminate.	Sagittal	Horizontal ○♂	○♀	
N. Bicristal / Biacromial Index	—←68	69 73	74 76	77 82	83→+
P. Strength (Kg) Grip (R+L)+Thrust +Pull	+←244	243 186	185 148	147 110	109→—
Grip (R+L)	+←126	125 95	94 80	79 59	58→—
Androgyny Score (Sum of "A"–"H")	8 12	13 19	20 B A 25	26 34	35
Characteristic Description (Circle one)	**Hypermasculine**	**Masculine**	**Intermediate Bisexual Asexual Disharmonious**	**Feminine**	**Hyperfemin[ine]**

Notes:

* To be used with manual of directions and chart of standards.

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Figure 4

or Sheldon's body types. Therefore these ratings should be made without regard to other build classifications.

Besides surface modeling, there are two separate body regions to be considered, one of these having three ratings and one four. A total of eight ratings of body contours and modeling, from rear view photographs, yield an androgyny score of body form.

I. Surface modeling

Surface modeling (A) is influenced by muscle, fat, bony protuberances, veins, and tendons.

The preadolescent is covered by a relatively uniform layer of subcutaneous fat, through which the contours of moderately developed muscles can be seen. As maturity approaches, the masculine modeling is influenced especially by the development of larger muscle masses, the feminine modeling by characteristic fat deposits. Veins and tendons stand out strong and prominent on the masculine arm, whereas they disappear into the contours of even a slender feminine arm.

"In men such observable localized bosses or protuberances as may appear are chiefly due to the well-developed muscles, which are covered only by a thin layer of subcutaneous fat." "The woman's muscles are not large and knotty, and may be completely hidden beneath a fairly thick, smooth panniculus" (Draper, '41, p. 80). These differences show especially in the leg and arm and, to some extent, in the shoulders. When both the muscle masses and the fat covering are strongly developed, the surface receives a "bisexual" rating.

II. Trunk

Shoulder girdle (B). In childhood, the shoulder girdle is not much wider than the trunk, and usually has a rather loose-knit appearance.

Maturity finds the masculine shoulder appearing wide, heavy, and muscular, in proportion to total size. In extreme

cases it may be described as "massive." Although this appearance is usually emphasized by the narrowness of the hips, shoulders should be rated regardless of hip width. The feminine shoulder remains slight and narrow with little muscle; it may look very frail or become more rounded with soft fat. Ratings are made from a combination of the factors of breadth, muscle, and fat.

Waistline (C). In the childish torso, the waistline is a slight and relatively high narrowing below the rib cage. The adult torso has more of an hour glass contour, broadening into the shoulder girdle above, and the pelvic crest below. The narrow band between the two funnels is the waistline, whose individual outlines vary in depth, acuity, and position, depending on the development of the two trunk girdles. Since the greater trunk breadth of the male is in the shoulder, and that of the female in the pelvis, the waist reflects the sex differences.

The masculine waist line is low and less clearly demarcated because there is no definite point at which the narrowing of the torso breaks into the widening of the hips. That is, it is typically lower than in childhood, appearing to be just above the pelvic crest. The feminine waistline is due less to a narrowing of the torso and more to the wide hips: it usually is a marked indentation, dipping in below the ribs (except where excess fat obscures the dip) and then out with the hip flare.

Pelvic girdle. Like the shoulder contour, the hips and buttocks in childhood do not widen out much from the trunk. During adolescence, the masculine outlines change very little; in this rating, it is the feminine differentiation which leads to the contrast between sexes.

Hip flare (D). The masculine hip widens only a little and very gradually from the waist, giving a long-bodied, low waisted effect. The feminine hip flares out from the waistline with a fat pad superimposed on a wide iliac crest. This gives a high-waisted effect; in the pictures, shading indicates an abrupt widening which extends somewhat toward the rear as well as laterally.

Buttocks (E). The masculine buttocks are muscular with little fat and tend to have deep concavities or dimples near the median line. In cross section at buttocks level the body would appear to be almost triangular, with the apex of the triangle at the center rear. Feminine buttocks are rounded and soft, amply filled out with fat, and in cross section curve out into a semi-circle.

III. Leg pattern

The legs in childhood also have only moderately developed fat and muscles so that preadolescent boys and girls show rather knobby or spindly open leg patterns. It is important to note that legs go through a characteristic development: bowlegs are typical at the earliest walking age; these often give way to knock-knees at age 3 to 5, and thereafter straighten out again into the healthy, straight childhood contour. With adolescence, masculine legs undergo the changes resulting especially from greater muscle masses and large bones; feminine legs become more rounded with fat and the thighs become closely approximated. As in the pelvic girdle, the masculine leg deviates less than the feminine from the preadolescent pattern. If for convenience the leg is examined in several aspects, the typical masculine and feminine deviations may be described as follows:

Thigh form (F). Typically masculine thighs have little fat, tending to be almost cylindrical in form; what widening there is at the crotch is due to muscular development. The muscles bulge laterally giving to the outline a characteristically convex curve. If a boy's muscles are tensed this muscle bulge is sometimes set off by a longitudinal groove formed by the intermuscular space posterior to the ilio-tibial tract of the tensor fascia latae. Feminine thighs are funnel-shaped, widening at the crotch smoothly because of the fat; the lateral outline tends to be convex.

Interspace (G). The interspace between the legs is typically open in the man, when the heels are approximated and the feet are parallel. Because of little fat and in many instances a

tendency to bow slightly at the knees, there is open space between the thighs as well as below the knees. Feminine interspace is very small due to fat and a tendency (because of the articulation of the femurs into a broad pelvis) for the knees to come together. The thighs are closely approximated, and the knees together; there is either a narrow space below the knees, or else with knock-knees and/or very fat thighs the feet are forced apart.

Lower leg muscular bulges (H). The inner outline of the masculine lower leg is very knobby and uneven, due primarily to the bulge of the inner belly of the gastrocnemius. This is a sharp bulge of muscle with little fat. The feminine legs are smooth, with moderate bulges (and in extreme cases no bulge) on the inside, this bulge being smoothed out with a layer of fat — a "shapely" leg with the outer curve often more pronounced than the inner. (3a legs have little development of either muscle or fat).

Note on asexual and bisexual ratings. After all eight ratings have been made, it is well to review any case whose ratings tend to be intermediate or "3," and decide (if this has not already been done) whether they are predominantly "a" or "b," and if so, for which characters. If the decision can not be made for the individual characters, it is still usually possible to make a note of the general impression, for use in the final summary.

The total score of androgyny is obtained by adding the eight ratings. When these eight rear view ratings are used, intermediate scores, especially those ranging between 19 and 26, should be considered asexual if there is a preponderance of 3a's comprising the score, and bisexual if there is a preponderance of 3b's. Typical masculine scores range from 13 through 17, and typical feminine scores 28 through 34 inclusive.

Supplementary criteria

Following are additional physical characteristics which may be of value in assessing the androgyny of the individual.

Degree of differentiation in penis and breasts (front view and side view). These ratings indicate degrees of sexual differentiation within the sex and have been adjusted to fall into

a bi-modal distribution similar to those found for the androgyny ratings of body form.

Boys: Size of penis (J). A five-point scale is developed in the masculine range of ratings by assigning the following numbers: 1 is very large, 1.5 large, 2 average, 2.5 small, and 3 extremely small. (See photographic standards, fig. 5a). Size is determined in relation to the subject's total size, and judgment based on consideration of a combination of length and width. It is necessary to try to take into account tumescence when present, and to discount it. For this reason a series of several pictures taken at different times is helpful.

Girls: Size of breasts (K). Numerical ratings are assigned to fit the feminine range of distribution on the rating scale, with a rating of 3.0 very small, 3.5 small, 4 average, 4.5 large, and 5 extremely large (see photographic standards, fig. 5b).

Hair distribution (LM). The distribution of pubic (M) and body (L) hair does not show the same type of androgynic variation as is found for body form. Our findings are corroborated by Dupertuis et al. ('45) who classified pubic hair from photographs of over a thousand 18-year-olds, and a smaller group of men and women aged 30 and 40 years. They distinguished four patterns, using the criterion of the shape of the upper outline of the pubic shield. These are: horizontal (the classical feminine), sagittal (few hairs on the sagittal line), acuminate (the classical masculine with triangular upward extension) and disperse (hair distributed generally over abdomen). Approximately 90% of 18-year-old women will be found to have the horizontal pattern, but so will about 40% of the men while the remainder will have varying amounts of the more masculine patterns.

For the ages under consideration here we can only note whether in the masculine to feminine order (L) the pattern is disperse, acuminate, sagittal, or horizontal, and whether (M) body hair, primarily on the thighs, is conspicuous, moderate, sparse, or absent. The appearance of the acuminate pubic pattern, and conspicuous thigh hair may have some significance as another factor indicating masculinity in both

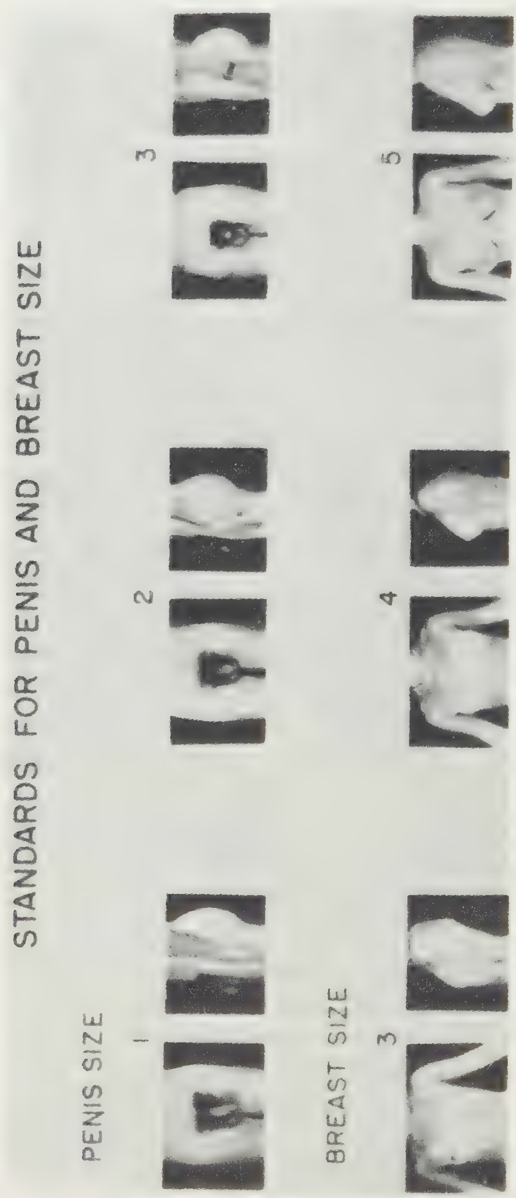
STANDARDS FOR PENIS AND BREAST SIZE
PENIS SIZE
1
2
3
BREAST SIZE
3
4
5

Figure 5

sexes. Because the absence of coarse body hair and the horizontal pubic pattern are characteristic of most women, they are appropriately rated "4" for women. But such a large percentage of normal young men also have these same patterns of hair distribution that a feminine rating for them is not justified. Therefore boys with these hair distributions are given ratings in the "3" column.

The bicristal/biacromial $\times$ 100 index (N) may be used as an objective check on the ratings of the photographs. The diameters are measured with sliding calipers, using the standard anthropometric technique. The measures on our standardization subjects at 17 years 7 months yield indices with a mean of 72, and S.D. of 3 for 77 males; and a mean of 78, S.D. 5 for 79 females. Deviation from the mean (for the same sex) of one S.D. or more would indicate an atypical ratio. Because there is considerable overlapping of the index for the sexes, we suggest the following adjustment to a five-point rating scale for use with our profile; rating 1, index of 68 or below; rating 2, index 69 to 73; rating 3, index 74 to 76; rating 4, index 77 to 82; rating 5, index 83 and above.[1]

One other index should be mentioned. When examining post-adolescents for incomplete sexual differentiation or eunuchoidism, the clinician commonly seeks to demonstrate an excess of limb length as related to total stature. Several techniques are in use: (a) comparison of total arm span with standing height; (b) leg length, as measured from symphysis or trochanter to floor, in percentage of stature; (c) stem length or sitting height in percentage of stature. We prefer the latter method as being more reliable and significant. Standards for reference are available in the anthropometric studies already quoted (Bayer, '39, '40; Bayley, '43) and in comprehensive endocrine text books.

[1] Any one interested in using the BC/BA index for an individual either younger or older than the late adolescents here described must refer to appropriate norms for standards. For children we suggest Gray and Ayres ('31). The mean for men is 76%, for women 85%; the normal masculine range is 70 to 80% (10) feminine range 80–90% (Bayer, '34).

In both sexes, the presence of a relative excess in limb length suggests a deficiency in sexual and skeletal maturation. It is therefore a frequent finding in intermediate, asexual builds, and its presence or absence should be noted in any case where hypogonadism is suspected. We have not provided for this measurement in the rating profile since it has no value for androgynic differentiation.

Strength (P) is another easily measured physical character with marked sex differences in adults. It changes with age to such an extent that the norms presented here should apply only to the 17–18-year age range. Scores may be based on right plus left grip only, or on a total of grips, thrust, and pull. A Collin-type hand hynamometer is used (Jones, in press). Three trials are given for each hand, and the best score for each hand is combined for the score. For the more complete tests, three additional trials each are given for pull and for thrust, and the score is the sum of the best trials for right and left grip, thrust and pull.

STATISTICAL ANALYSIS OF THE RATING SCALE

After the rating scale had been developed on the small pilot group, it was tested by application to two groups of cases.[2] The larger group consisted of 79 girls and 77 boys from the Adolescent Growth Study (Jones, '39). They were rated from two different sets of photographs. In one set, the pictures were equated for skeletal age; based on hand and knee x-rays assessed according to Todd's standards (Todd, '30, '37). Girls at the first mature rating (Sk.A. 16 years 3 months) and boys at the most mature age for which a reasonably complete sample was available (Sk.A. 17 years 3 months). The second set of photographs was made up of the cases at chronological age 17 years or older (the oldest at 18.8 years) regardless of skeletal age: the mean age of this group was 17 years 7 months. This somewhat older age group has the advantage,

[2] All of the photographs were obtained in longitudinal studies in which the same children were tested, measured and photographed every 6 months for at least 6 years.

for most of the cases, and especially the girls, of generally more advanced physical maturity, with greater sexual differentiation of body form. A final group consisted of 31 skeletally mature girls 17 years or older from another sample (Macfarlane, '38). Independent ratings were made, by the two authors, of all three sets of photographs.

Additional independent ratings were made by two relatively untrained persons who were asked to rate the Adolescent Study photographs according to the specified criteria. These raters had assisted with anthropometrics on adolescents, but had not worked previously with the androgyny scale. Their ratings were secured to test further the objectivity with which the standards could be used. As a result of this experience alterations were made in the directions before the third set of girls was rated.

The numerical androgyny score. The reliability and validity of the obtained androgyny scores have been studied by various statistical devices. By ignoring temporarily the asexual and bisexual ratings, correlation coefficients could be computed between the numerical ratings given by the four different raters. Furthermore the total androgyny score, composed of the sum of eight ratings, could be similarly compared.

The frequency distribution of obtained androgyny scores at 17.6 years is shown in figure 6. The scores used in this chart are the average of the androgyny scores computed from the authors' independent ratings.

It is evident from the correlation coefficients in table 2 that the four sets of androgyny scores are in fairly good agreement. This means that the pictures and descriptions give sufficiently objective criteria to permit substantial agreement among different persons using the scale.

As for the separate items, the agreement is also substantial, as shown by the correlations between two pairs of raters, which are presented in table 3. When we consider that these *r's* are based, in most instances, on a rating scale in which most of the ratings for one sex are restricted to a range of three points, the agreement may be considered very good.

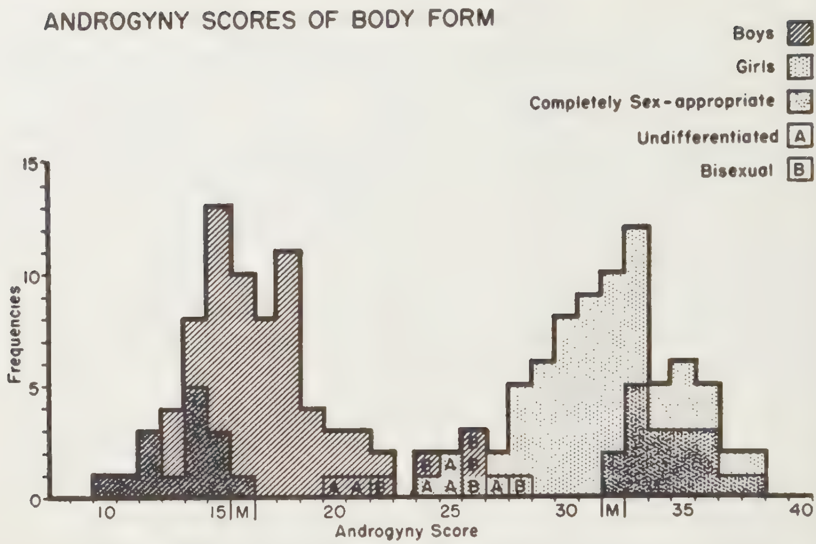

Fig. 6 Frequency distribution of androgyny scores of seventy-nine girls and seventy-seven boys with an average age of 17.6 years.

TABLE 2

The reliability of androgyny scores: Correlations between assessments of four raters at C. A. 17.6 years.

RATERS COMPARED	ADOLESCENT STUDY CASES AVERAGE AGE 17.6 YEARS		GUIDANCE STUDY GIRLS WITH MATURE SKELETAL AGE, 17 TO 18 YEARS
	77 boys	79 girls	31 girls
	r	r	r
NB by LMB	.72	.83	.79
NB by ER	.75	.77	.62
NB by MS	.79	.82	.66
LMB by ER	.76	.74	.65
LMB by MS	.79	.77	.72
ER by MS	.82	.80	.59

A further analysis of the items in the rating scale, as rated by Bayley, was made by correlating each rating with the total androgyny scores (table 4). These r's show that the ratings of the individual body areas are in substantial agreement with the total. If any one were in perfect agreement with the total, that one alone would constitute a sufficient rating. But each

TABLE 3

Reliability of ratings of individual items in the androgyny score: Coefficients of correlation between two pairs of raters: seventy-seven boys and seventy-nine girls at age 17.6 years.

	NB BY LMB		MS BY ER	
	Boys	Girls	Boys	Girls
	r	r	r	r
A. Surface modeling	.61	.43	.76	.79
B. Shoulder girdle	.62	.26	.61	.35
C. Waistline	.38	.64	.34	.47
D. Hip flare	.42	.60	.50	.44
E. Buttocks	.70	.51	.69	.69
F. Thigh form	.45	.65	.48	.73
G. Interspace	.81	.82	.71	.59
H. Calf muscle	.69	.55	.67	.45

TABLE 4

The relation of each item to the total androgyny score for ratings made by NB (seventy-seven boys and seventy-nine girls at average age of 17.6 years):

Correlation of separate items with total of eight.

ITEM	BOYS	GIRLS
A. Surface modeling	.67	.48
B. Shoulder girdle	.60	.35
C. Waistline	.52	.54
D. Hip flare	.62	.67
E. Buttocks	.68	.71
F. Thigh form	.72	.82
G. Interspace	.61	.73
H. Calf muscle	.66	.60

appears to contribute a fair share to the total score. There is some tendency for the degree of correlation of an item to be higher for the sex in which that item shows significant variation. For example the shoulder girdle correlates .60 with boys' total scores and only .35 with the girls' scores; while there is a slight tendency for the girls to have higher correlations in the items influenced by their broadening pelvic girdle.

The intermediate cases

Persons with androgyny scores intermediate between those appropriate for their sex are, as we have indicated above, of two general kinds. Some individuals never develop builds fully characteristic of mature members of their sex; they remain relatively undifferentiated. Others show strong characteristics of the opposite sex, but with variation in both the degree and the direction of predominant differentiation. Persons with disharmonious differentiation of the body segments may exhibit both "asexual" and "bisexual" characteristics, as well as other incongruities.

In normal persons, such as the subjects of our research, there are very few instances of outstanding deviation from the sex-appropriate build, and when the deviations are observed they are usually in so mild a form that it is often difficult to decide whether or not to note them. For this reason, statistical treatments do not show high reliability for "a"-score and "b"-score ratings. However, in the more clear-cut cases in our sample whenever all four raters gave some "b" scores (bisexual ratings) that case was seen on review to have some very obvious characteristics of the opposite sex. Undifferentiated characteristics, on the same criterion, were found for five of the girls and ten of the boys. The larger number of immature builds in boys is related to the fact that the boys, though the same age, were physically less mature.

All of the twelve cases for whom all four raters agreed that there were marked asexual or bisexual characteristics have androgyny scores in the intermediate range. An average of three "a" or "b" scores per rater, was considered "marked" or "high." Their positions on the frequency distribution are shown on the bar diagram in figure 6.

If we relax the criterion to include cases on whom three raters agree, there are in addition ten girls and seven boys having bisexual ratings, one of each scoring high; and six girls and fourteen boys having asexual ratings, two girls and one boy scoring high. As is to be expected, on review of these

photographs the raters agreed that the indicated characteristics were present, but in a lesser degree. The failure to differentiate such individuals would probably be unimportant in practical application, because they are so near to the normal in androgyny.

On the other side of the picture, there were eighteen girls and fifteen boys for whom no one gave either "a" or "b" ratings, and who evidently have builds which exhibit in all respects definite or strong differentiation appropriate for their sex. They are indicated as darker-shaded areas in the frequency distribution (fig. 6), and are seen to comprise most of the cases in the extremes of the distribution. Among them are to be found the few cases who are hyperfeminine and hypermasculine, with extreme androgyny scores.

In general only androgyny patterns having a considerable shift away from the sex-norm have any clinical significance for the individual case. The occurrence of an occasional 3a or 3b character is well within the range of expected individual variation.

Supplementary ratings

The supplementary ratings show varying degrees of relationships to the androgyny scores of body form. Ratings of breast size were found to correlate .49 with the androgyny score, while ratings of penis size correlated zero.[3] Breast size of girls is thus seen to be congruent with body form. But penis size in normal boys appears to be independent of androgyny as exhibited in physique. It should therefore have little weight in the assessment of body form in spite of its obvious significance for the individual.

The development of coarse terminal hair on the body occurs slowly throughout adult life; many 18-year-old boys have not yet developed heavy hair on chest or thighs and do not have the acuminate pattern of pubic hair. Because of this, the lack

[3] These characters can be rated reliably. Correlations between independent raters for penis size of boys are .73 between N.B. and L.M.B. and .77 between M.S. and E.R. Ratings of breast size of girls correlated .85 between N.B., and L.M.B. and .85 between M.S. and E.R.

of masculine hair distribution could mean immaturity, incomplete masculine differentiation, or bisexual differentiation. For our subjects the density of hair on the thighs was rated by Bayley on a four-point scale (dense, moderate, slight and absent) from the photographs of the boys at C.A. 17.6 years. These ratings correlated only .03 with the androgyny scores (average of N.B. and L.M.B. ratings) based on ratings of the same photographs. Similarly, correlation of androgyny score with the four patterns of pubic hair (Dupertuis, '45) yields a coefficient of only .04. Although there is thus no relation between androgyny and hair distribution in these boys, some correlation might be expected for more mature men. Body hair on the girls was observed in only a few cases in small amounts along the sagittal line, and on the thighs. These cases were distributed throughout the range of androgyny scores, again indicating no relationship in normal girls at these ages.

Anthropometric indices have the advantage of relative objectivity, and express fairly clear, simple relationships. However, even for the bicristal/biacromial index, which shows most sex difference, there is considerable overlapping between sexes. For this reason the index should not be given great weight as a factor in androgynic differentiation. There is, nevertheless, some relationship, as seen in the low but positive correlations between bicristal/biacromial index and androgyny scores,[4] of .35 for boys and .27 for girls.

For clinical use, where the aim is to find and weight elements of disharmony within the physique, the making of a composite androgynic profile as here developed is a more flexible assessment than can be made by the device previously worked out by Bayer ('40), in which the critical basis was the bicristal/biacromial ratio. With the present instrument, the disharmonious elements can be identified, whereas the previous method merely gave "mixed" builds a label. Especially in the search for psychosomatic relationships the isolation of

[4] Reliability of the bicristal/biacromial index was increased by using the average of indices obtained from three successive measurings made at 6-month intervals. The androgyny score used is the average of the authors' independent ratings.

conflicting elements may prove to be more crucial even than the assignment of a rating or type.

Strength tests are simple objective measures with large differences between sexes after maturity. However, for our 17.5-year-olds the correlations within each sex, between strength and other aspects of androgyny were found to be low. Total strength score correlated with the androgyny scores —.24 for seventy-two boys and .07 for seventy-eight

TABLE 5

Intercorrelations between androgyny, strength, height and weight.

SIMPLE CORRELATIONS	72 BOYS	78 GIRLS
Androgyny by strength	—.24 [1]	.07
Androgyny by height	.00	.01
Androgyny by weight	.06	.55 [2]
Strength by height	.41 [2]	.25 [2]
Strength by weight	.66 [2]	.24 [2]
Height by weight	.63 [2]	.48 [2]
PARTIAL CORRELATIONS [3]		
Androgyny by strength, height constant	—.27 [1]	.07
Androgyny by strength, weight constant	—.35 [2]	.07
Androgyny by weight, height constant	.08	.62 [2]
Strength by weight, height constant	.57 [2]	.14
Androgyny by strength, weight and height constant	—.38 [2]	—.02

[1] Significant at the 5% level.

[2] Significant at the 1% level.

[3] By the standard formulae, as given in Mills ('38, p. 555). Negative correlations indicate that the more masculine persons are stronger, as the masculine androgyny score is low, the feminine high.

girls (table 5). There seemed, furthermore, to be no consistent differences between the asexual and bisexual cases within the sex group.

Other factors of size and physique may be strong enough to obscure any tendency for the more masculine individuals within the sex group to be actually stronger. Jones (in press) for example, has found positive correlation between strength and size of these adolescent boys. The effect of size on androgyny-strength relationships is here investigated by means of

partial correlations. We see from the correlations in table 5 that among the boys strength is significantly correlated with weight and height, and when these measures of size are held constant (statistically) the correlation of androgyny to strength is increased to —.38. Although the relation is not high, it is a significant one. For girls, on the other hand, holding weight and height constant has little effect on the relation between androgyny scores and strength: the partial correlation remains at zero.

This sex difference may be explained in part by an examination of the other correlations in table 5. Among the girls the relationships between weight and height and strength are lower than among boys. Furthermore, the most striking sex difference in these correlations is between androgyny and weight. It appears that our ratings of androgyny in girls are greatly influenced by their weight which is probably determined largely by the amount of fat. Breast size is similarly related to weight, showing a .45 correlation with the weight/stature index. In boys, on the other hand, weight due to fat (a feminine characteristic) is balanced out by weight due to large muscles (a masculine characteristic), resulting in a zero correlation between androgyny and weight. Incidentally, although height is another physical factor in which the sexes differ, its correlation with the androgyny score is zero for both sexes. It is probable, nevertheless, that strength and size will be of diagnostic and psychological importance in the evaluation of cases who are strongly deviate in their patterns of androgyny.

ANDROGYNY VS. SOMATOTYPE

A word may be said about the relation of the concept of androgyny as here developed to the somatotypes of Sheldon's system. In describing endomorphy, mesomorphy, and ectomorphy, Sheldon invokes certain theoretical relationships, as for instance, that fat deposition goes with a large gastrointestinal tract. Whether or not such assumptions are valid,

they have no immediate relation to our present concern with sexual development and differentiation.

Seen in the simplest terms, the form and covering of the body depends in large part on the absolute and relative amounts of fat, muscle and bone. These are distributed, according to the scheme of somatotypes, into endomorphs who have a predominance of fat, mesomorphs who have a predominance of muscle (and a heavy skeletal frame), and ectomorphs who have a relative absence of both fat and muscle, leaving a frame which is largely skin and bones.

If these same factors are now related to current theories of sexual differentiation, they take on a different meaning. Assuming healthy individuals, with height, weight, and certain other basic elements equal, then fat predominance becomes a feminine trait and muscularity a masculine one, while their absence implies a lack of differentiation. In addition, large bones are characteristically masculine, while small bones are found in both feminine and undifferentiated builds. Since such a picture is readily related in a dynamic way both to our modern psychologies of personality development, and to current work on metabolism and hormones, it seems to us that looking at the body in terms of androgyny, even though this is admittedly a limited view, gives a useful base from which somatic diagnosis can be made and psychosomatic relations sought.

SUMMARY AND CONCLUSIONS

A rating scale has been devised for assessing androgyny in young adults of both sexes. Standards are presented in the form of illustrative photographs, detailed descriptions, and a rating chart for constructing individual profiles. Subjects are rated according to both degree and direction of sexual differentiation (hypermasculine, masculine, intermediate, feminine, hyperfeminine). Cases with intermediate scores may be relatively undifferentiated (asexual) or show characteristics of the opposite sex (bisexual). A frequency distribution of the scores falls into a bi-modal continuum with only a small

amount of overlapping of the sexes. Substantial agreement between four different raters shows the scale to be reliable.

Androgyny appears to be truly a "mosaic" as Draper has so aptly labeled it. Valid sex differences having little or no overlap between masculine and feminine scores may be very little related to each other in their variations within a sex. Specifically, the androgyny score is not related to penis size, but has a fair correlation with breast size: it is not related to amount or distribution of coarse body hair: it is related moderately to strength in boys, but not in girls: it is only slightly correlated with the bicristal/biacromial index: it is not correlated with stature in either sex, or with weight in boys, but is strongly related to weight in girls. It thus becomes obvious that many individuals may deviate in a few characteristics; few will deviate in many.

With these standards for assessing somatic androgyny it should be possible to determine its relationship to personality structure. Significant differences in personality may well be found between those with normal builds, relatively immature builds, and with build characteristics of the opposite sex. Androgyny scores may also prove useful in relating sex variations in physique to other aspects of body build, to physical fitness, to psychosis, and to hormone assays.

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Early Excursion into Craniology.— Vesalius [1514–1564] groups skulls, according to shape, in five categories. Much has been written about his classification. It is not our intention to discuss it here. Suffice it to state that whatever its resemblance to the classifications of modern anthropologists, it differs fundamentally in both spirit and purpose. Rather, it follows good Galenic tradition. For Vesalius, there is only one "natural" form of skull, all variants therefrom being regarded as unnatural. He states: " . . . And for this reason too, the skull which is according to nature is chiefly built in the shape of an oblong sphere, here the anterior parts are more prominent and larger. But all the other figures which vary from this one, are believed not to be natural . . . " — William L. Straus, Jr. and Owsei Temkin. Vesalius and the problem of variability. Bull. Hist. Med., vol. 14, no. 5, 1943. (Includes a good reproduction of the plate in the "Fabrica" showing Vesalius' five types of human skulls.)

EFFECT OF CULTURE ON THE HUMAN ORGANISM.— The extent to which the human individual is a social product is indeed astonishing. The human individual would not be human were it not for the social milieu. The forms of cultural effect upon the physiological individual include such practices as cicatrization, tooth-extraction, nose-boring, head-shaping, foot-binding, neck-elongating, lip-distending, ear-boring and -distending, infibulating and circumcising. The psychological individual also changes in relation to the demands of his social group to a remarkable degree. Some of these changes are: in thresholds of pain (ready response or lack of response) and in emotional responses (weeping out of sorrow or out of a sense of duty). The social influence is evident likewise in the institutional capacities and performances of the individual. He acts as a father (the family); a taxpayer and voter (politics, the state); a breadwinner (economics, business); etc. All these functions exemplify social incursions into the individual and not the reverse.— James Feibleman. *The theory of human culture.* Duell, Sloan and Pearce, New York, 1946, xiv + 361 pp.

TENDENCY TO DIABETES BY NATIONALITY.— The Old Americans appeared to have the lowest incidence of glycosuria and diabetes compared with the control group. On the other hand, the Canadian-French had more than twice as many in the glycosuria and diabetic group. The Irish, who constituted 11% of the control group, had 18.6% in the glycosuria group and 22.3% of the diabetic. The English had a much greater incidence of diabetes than expected because they constituted 11.5% of the diabetic compared with 5% of the controls and 8.4% of the glycosuric. The Jews had 8.4% of the glycosuric compared with 6% of the control group, which is only a slight increase. A most striking observation was that the incidence of Jews was the same in the 332 newly discovered and known diabetics as in the controls. Furthermore, the incidence of Jews was only 4.1% in the newly discovered cases compared with 9.1% of the known cases. In the past it was considered that the Jews had a much greater incidence of glycosuria and diabetes than other nationalities. This study does not substantiate this idea. It appears likely that the reason glycosuria and diabetes were found so frequently in the Jews in the past is that they live in urban areas chiefly and appear to visit the doctor quite readily for various complaints and consequently more routine urine examinations were made. As a result, more recognized cases of glycosuria and diabetes were found in them. —Harry Blotner. Studies in glycosuria and diabetes mellitus in selectees. J. Am. Med. Assn., vol. 131, no. 14, 1946, pp. 1109–1114.

REGIONAL DIFFERENCES IN THE PHYSICAL CHARACTERISTICS OF AN AMERICAN POPULATION

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The present analysis is based on measurements taken by John A. Cosentino and Paul Reiter, as part of a project conducted by the Chemical Warfare Service Development Laboratory at the Massachusetts Institute of Technology. The larger part of the data was collected by Mr. Cosentino, who was also of particular assistance in some of the calculations represented by the tables of this paper. Dr. E. A. Hooton of Harvard University acted in an advisory capacity for the selection of measurements and techniques. Mr. John Charles Kelley collaborated in the standardization of measurements, but did not actually take part in collecting the data here analyzed. A fortunate aspect of the survey is that all measurements were taken at the same place (Camp Sibert, Alabama), so that observer differences are randomized with respect to regional differences in the origin of the population.

The population measured consists of 3075 enlisted men, comprising a wide sampling of the total white male population of the United States. The age distribution, as given in table 1, is of course a selected one. Distribution by regions is classified according to the standard census grouping (table 2). Comparison of the distribution by birthplace with that of the total population in 1920 (nearest census date to the average year of birth of the group) shows considerable discrepancy, with an excess in the present series of individuals born in the South Atlantic and East South Central areas

(table 3). Since the comparison is a crude one and does not take into account any regional differences in birth rates, no conclusion can be drawn regarding the representativeness of this sample other than that the southeastern part of the country is apparently overrepresented.

Forty head and face measurements were taken on each individual, since full detail was desired for purposes of constructing sculptured heads from the assembled data. Many of these measurements were of an obscure nature and some proved to be highly unreliable; hence in table 4 only those measurements are given which are described in Martin's Lehrbuch (some of these in fact are not very reliable for purposes of comparison) and four radial measurements from

TABLE 1

Age distribution.

AGE (YEARS)	PER CENT	AGE (YEARS)	PER CENT
16–17	.1	28–29	7.5
18–19	16.7	30–31	6.7
20–21	15.6	32–33	6.8
22–23	12.5	34–35	5.8
24–25	12.2	36–37	4.9
26–27	9.1	38 and over	2.2

tragion to the midline of the facial profile, which offer promise of future usefulness. Stature has been included in some of the following tables. The stature data, however, should not be used except for purposes of comparison within these tables; the measurement was taken with shoes and has been corrected by subtraction of one inch, which brings the figure into conformity with data of the Surgeon General's office for the army as a whole by making the average of the total group 68.1 inches.

Eight principal measurements, together with stature, were chosen for analysis according to national extraction and state of birth. National extraction was grouped for statistical purposes by the system given in table 5. The extraction of

TABLE 2

Division of birthplace data into major regions.

DESIGNATION	STATES INCLUDED
New England	Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut
Middle Atlantic	New York, New Jersey, Pennsylvania
East North Central	Ohio, Indiana, Illinois, Michigan, Wisconsin
West North Central	Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas
South Atlantic	Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida
East South Central	Kentucky, Tennessee, Alabama, Mississippi
West South Central	Arkansas, Louisiana, Oklahoma, Texas
Mountain	Montana, Idaho, Wyoming, Colorado, Arizona, New Mexico, Utah, Nevada
Pacific	Washington, Oregon, California

TABLE 3

Regional representativeness of the series.

BIRTHPLACE	PER CENT OF NATIVE BORN	PER CENT TOTAL POPULATION, 1920 (APPROXIMATE AVERAGE BIRTH DATE OF SERIES)
New England	5.6	7.7
Middle Atlantic	23.5	22.8
East North Central	15.8	22.1
West North Central	8.5	12.9
South Atlantic	20.9	10.2
East South Central	17.5	6.7
West South Central	4.9	8.6
Mountain	1.8	3.4
Pacific	1.5	5.6
Foreign-born (per cent of total)	2.9	...

individuals was classified according to the principal extraction of each parent, as stated by the subject. A single extraction designation for each parent of course allows a subject to be "mixed" where the national extractions of the parents are different. It seems evident that considerably more mixture must exist than was recorded by this system, which necessitates trimming every family tree to two branches. Over two-thirds of the group, in fact, are recorded as having a single,

TABLE 4

Chemical Warfare Service series, total.

MEASUREMENT	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIABILITY	RANGE
	mm.	*mm.*		*mm.*
Head length (1)[1]	195.03	6.92	3.55	165–218
Head breadth (3)	152.84	5.62	3.68	134–175
Bitragion (5)	141.49	5.56	3.93	121–168
Minimum frontal (4)	109.82	4.83	4.40	91–129
Bizygomatic (6)	139.83	5.34	3.82	122–159
Bigonial (8)	104.73	5.59	5.34	86–127
Tragion-nasal root	122.00	4.50	3.69	106–139
Tragion-subnasale	126.58	4.97	3.93	107–148
Tragion-supramentale	132.63	5.35	4.03	112–151
Tragion-anterior chin projection	144.14	5.93	4.11	119–165
Crinion-menton (17)	185.45	9.28	5.00	152–231
Crinion-nasion (24)	63.23	7.72	12.21	35–94
Nasion-menton (18)	123.78	6.71	5.42	101–151
Nasion-subnasale (21)	54.51	3.83	7.01	41–70
Nasion-pronasale (23)	51.31	4.07	7.93	38–69
Nasion-mouth slit (19)	76.68	4.49	5.86	60–101
Bimalar (7a)	109.56	6.48	5.91	86–133
Biocular (10)	91.46	4.16	4.55	70–108
Interpupillary (12)	62.83	3.84	6.11	47–79
Interocular (9)	31.84	2.66	8.35	20–43
Nose breadth (13)	35.10	2.73	7.78	21–56
Mouth breadth (14)	50.08	3.34	6.67	36–63
Ear implantation (32)	49.97	4.07	8.14	38–67
Ear length (29)	63.90	3.98	6.22	49–78
Head circumference (45a)	566.24	15.54	2.76	504–617
Number of cases	3075			

[1] Numbers in parentheses refer to standard measurement descriptions as given by Martin ('28).

simple, national extraction. Even if the records cannot be accepted strictly at face value, however, they appear from the analysis of the measurement data to be essentially valid, since marked physical differences between the extraction groups appear.

TABLE 5

Classification of national extractions.

DESIGNATION	AREAS INCLUDED
British	Great Britain, English-speaking Dominions, except Northern Ireland
Irish	Eire and Northern Ireland
Latin American	Mexico, Central and South America
Scandinavian	Scandinavia, Finland
Germanic	Germany, German Switzerland, Austria, Holland
Gallic	France, Belgium, French Canada
Slavic	Poland, Czechoslovakia, Hungary, Baltic States
Russian	European and Asiatic Soviets
Balkan	Rumania, Bulgaria, Yugoslavia, Albania, Greece
Mediterranean	Spain, Portugal, Italy, Azores, Cape Verde Islands, North Africa
Near Eastern	Turkey, Syria, Cyprus, Palestine, Armenia, Middle East
Note:	
Old American	This term was applied to the extraction of the subject's parent only if the ultimate (European) extraction of the parent was composite or not definitely known, and if his or her parents (i.e., subject's grandparents) were born in the United States. If a subject stated his parent's extraction simply and positively, it was recorded as stated without reference to nativity of grandparents.

Table 6 gives the average stature and eight head measurements for the nine largest groups of ostensibly "pure" extraction. (The omitted "pure" groups contained less than twenty individuals each.) The significance of the differences

TABLE 6

A. Stature and head and face measurements, by national extraction.

	OLD AMERICAN	BRITISH	IRISH	SCANDINAVIAN	GERMANIC	GALLIC	SLAVIC	RUSSIAN	MEDITERRANEAN	TOTAL U.S.
Stature (inches)[1]	68.1	68.5	68.1	69.0	67.8	66.6	67.9	67.3	66.5	68.1
Head length (mm)	195.8	196.6	195.8	194.9	193.4	193.1	190.2	192.6	193.2	195.0
Head breadth	151.6	152.0	152.7	153.5	154.2	153.3	157.3	154.2	152.9	152.8
Nasion-menton	123.5	124.2	124.1	123.4	123.2	124.5	123.8	123.6	125.7	123.8
Bizygomatic	139.0	139.1	139.4	140.6	140.7	139.4	142.8	141.4	140.5	139.8
Bigonial	104.6	104.7	104.5	105.4	105.7	105.1	106.1	104.2	104.0	104.7
Tragion-nasal root	121.5	122.1	121.3	122.6	122.2	121.4	122.7	123.0	122.4	122.0
Nose length	54.4	54.2	54.0	54.0	54.6	54.3	54.7	55.9	55.9	54.5
Nose breadth	34.7	34.7	34.7	35.9	35.3	34.7	36.0	36.3	36.1	35.1
No. of cases	781	386	213	56	218	47	176	103	161	3075

B. Direction and significance of differences from total group.

	OLD AMERICAN	BRITISH	IRISH	SCANDINAVIAN	GERMANIC	GALLIC	SLAVIC	RUSSIAN	MEDITERRANEAN	AVERAGE SIGNIFICANCE
Stature	+ 0.3	+ 2.6	— 0.1	+ 2.4	— 1.6	— *3.7*	— 1.3	— 2.9	— *7.8*	± 2.52
Head length	+ 2.9	+ *4.4*	+ 1.7	— 0.2	— *3.5*	— 1.9	— *9.4*	— *3.6*	— *3.4*	± 3.44
Head breadth	— *6.4*	— *3.0*	— 0.3	+ 0.9	+ *3.5*	+ 0.5	+ *10.6*	+ 2.4	+ 0.1	± 3.08
Nasion-menton	— 1.0	+ 1.1	+ 0.8	— 0.4	— 1.3	+ 0.8	+ 0.1	— 0.3	+ *3.7*	± 1.06
Bizygomatic	— *4.4*	— 2.7	— 1.1	+ 1.1	+ 2.3	— 0.6	+ *7.1*	+ *3.0*	+ 1.6	± 2.65
Bigonial	— 0.5	— 0.2	— 0.5	+ 0.8	+ 2.5	+ 0.4	+ *3.2*	— 0.9	— 1.6	± 1.18
Tragion-nasal root	— *3.4*	+ 0.4	— 2.3	+ 1.0	+ 0.8	— 0.8	+ 2.1	+ 2.2	+ 1.3	± 1.59
Nose length	— 0.8	— 1.4	— 2.1	— 1.0	+ 0.5	— 0.4	+ 0.8	+ *3.7*	+ *4.8*	± 1.72
Nose breadth	— *4.1*	— *3.1*	— 2.2	+ 2.2	+ 1.2	— 1.0	+ *4.2*	+ *4.5*	+ *4.9*	± 3.44
Average significance (±)	2.64	2.10	1.23	1.11	1.91	1.12	4.31	2.61	3.24	2.35

of the subgroups from the total has been calculated on the simplest possible basis. It is assumed that the means of the total group represent, for purposes of comparison with subgroups, the absolute values of a specific statistical universe. No sigmas were calculated for the subgroups. The standard of significance in each case is the standard deviation of the total group divided by the square root of the number of cases in the subgroup, which measures the probability that a subgroup mean could have been derived by random sampling from the total 3075 cases. Since a sigma is taken as divisor, differences over 3.0 (italicized) are significant. The large size of the series gives an abundance of significant differences, though these differences are not always large in absolute magnitude.

The average ratios of difference/sigma-of-difference for each measurement and for each national extraction group are appended to table 6. These averages show that of the measurements cited head length, head breadth and nose breadth rate highest in respect to differentiation by national extraction, with the bizygomatic diameter and stature in an intermediate place. Face length rates lowest of all as a subgroup differentia, though it is significantly different in one subgroup (Mediterranean).

Of the national extraction groups, the Slavic is most strongly differentiated from the total population, its average significance of difference for nine measurements being 4.3 sigma. The significant differences are: plus in head breadth, bizygomatic, bigonial and nose breadth, and minus in head length. The other groups, in order of decreasing amount of distinctiveness from the total, are:

Mediterranean, significantly less than average in stature and head length, and more than average in face length, nose length and nose breadth.

Old American, significantly less than average in head breadth, bizygomatic, tragion-nasal root, and nose breadth.

Russian, significantly less than average in head length, and more than average in bizygomatic, nose length and nose breadth.

British, significantly more than average in head length, and less than average in head breadth and nose breadth.

Germanic, significantly less than average in head length and more than average in head breadth.

Irish and Scandinavian, with no significant differences from the average.

Gallic, with a low average differentiation, but a significant deficiency in stature.

Table 7 gives a similar analysis of the same nine measurements according to the nine census regions of the United States. There are no "mixed" types here, since the sorting is according to the birthplace of the subject himself. The rather surprising fact appears that, although none of the regional groups are as distinctive physically as the Pure Slavic and Pure Mediterranean extractions, the average differentiation, measured according to the ratio of difference/sigma-of-difference, is four fifths as large among regional groups within the United States as among the national extraction groups. Head length, head breadth, and nose breadth are again the most critical measurements. The regional groups, in order of decreasing amount of distinctiveness from the total, are:

Middle Atlantic, significantly less than average in head length, and more than average in head breadth and bizygomatic.

South Atlantic, significantly more than average in head length, and less than average in head breadth, bizygomatic and nose breadth.

East South Central, significantly more than average in head length, and less than average in nose breadth.

East North Central, significantly more than average in head breadth.

West South Central, significantly less than average in head breadth.

	NEW ENGLAND	MIDDLE ATLANTIC	EAST NORTH CENTRAL	WEST NORTH CENTRAL	SOUTH ATLANTIC	EAST SOUTH CENTRAL	WEST SOUTH CENTRAL	MOUNTAIN	PACIFIC	TOTAL U.S.
Stature (inches)[1]	67.7	67.7	68.1	68.7	68.4	68.2	68.0	68.9	68.9	68.1
Head length (mm)	193.8	193.5	194.1	195.2	196.1	196.8	195.4	196.9	196.8	195.0
Head breadth	153.2	153.7	153.9	152.8	151.7	152.1	151.4	152.2	154.6	152.8
Nasion-menton	124.1	124.0	124.2	124.2	123.4	123.0	122.4	125.0	124.5	123.8
Bizygomatic	139.1	140.5	140.2	140.4	139.0	139.2	140.9	139.4	141.9	139.8
Bigonial	103.6	104.6	105.1	104.6	104.4	104.8	105.9	104.9	106.2	104.7
Tragion-nasal root	121.9	122.2	122.4	122.2	121.8	121.8	121.3	120.9	122.3	122.0
Nose length	54.8	54.8	54.6	54.8	54.2	54.2	53.9	54.7	54.9	54.5
Nose breadth	35.0	35.3	35.5	35.1	34.8	34.5	35.3	35.7	35.8	35.1
No. of cases	166	701	473	252	623	522	146	54	46	3075

B. Direction and significance of differences from total group.

	NEW ENGLAND	MIDDLE ATLANTIC	EAST NORTH CENTRAL	WEST NORTH CENTRAL	SOUTH ATLANTIC	EAST SOUTH CENTRAL	WEST SOUTH CENTRAL	MOUNTAIN	PACIFIC	AVERAGE SIGNIFICANCE
Stature	— 1.8	— *4.4*	+ 0.3	+ *3.5*	+ 2.3	+ 0.9	— 0.4	+ 2.1	+ 1.9	± 1.96
Head length	— 2.2	— *5.8*	— 2.8	+ 0.3	+ *3.8*	+ *6.0*	+ 0.6	+ 2.0	+ 1.8	± 2.81
Head breadth	+ 0.7	+ *4.2*	+ *4.1*	— 0.1	— *4.9*	— 2.9	— *3.1*	— 0.8	+ 2.1	± 2.54
Nasion-menton	+ 0.6	+ 0.7	+ 1.4	+ 1.0	— 1.2	— 2.7	— 2.5	+ 1.3	+ 0.7	± 1.57
Bizygomatic	— 1.8	+ *3.1*	+ 1.5	+ 0.6	— *3.9*	— 2.7	+ 2.5	— 0.6	+ 2.6	± 2.26
Bigonial	— 2.6	— 0.6	+ 1.3	— 0.5	— 1.6	+ 0.4	+ 2.5	+ 0.2	+ 1.8	± 1.28
Tragion-nasal root	— 0.3	+ 1.4	+ 1.9	+ 0.6	— 1.0	— 1.1	— 1.9	— 1.7	+ 0.4	± 1.14
Nose length	+ 0.8	+ 1.8	+ 0.7	+ 1.0	— 2.2	— 1.6	— 1.8	+ 0.4	+ 0.6	± 1.21
Nose breadth	— 0.7	+ 2.2	+ 2.8	+ 0.2	— *3.2*	— *4.9*	+ 1.0	+ 1.6	+ 1.7	± 2.03
Average significance (±)	1.28	2.69	1.87	.98	2.68	2.58	1.81	1.19	1.51	1.87

[1] Corrected from value taken with shoes; see text.

Pacific, New England and Mountain, with no significant differences from average.

West North Central, with low average difference, but a significant excess in stature.

Particular attention may be given to the cephalic index, which has been highly regarded as a differentia among the European races (table 8). The cephalic index was not calculated for individuals, so that comparative values have been derived from the head length and breadth means of the

TABLE 8

Cephalic index by birthplace and national extraction.

	CEPHALIC INDEX [1]	DIRECTION AND SIGNIFICANCE OF DIFFERENCE FROM TOTAL [2]
Total U. S.	78.4	
Birthplace		
New England	79.0	+ 2.2
Middle Atlantic	79.4	+ *7.7*
East North Central	79.3	+ *5.6*
West North Central	78.3	— 0.5
South Atlantic	77.4	— *7.1*
East South Central	77.3	— *7.3*
West South Central	77.5	— *3.1*
Mountain	77.3	— 2.3
Pacific	78.6	+ 0.4
Mean significance, birthplace groups		± 4.02
National extraction		
Old American	77.4	— *8.3*
British	77.3	— *6.1*
Irish	78.0	— 1.7
Scandinavian	78.8	+ 0.8
Germanic	79.7	+ *5.4*
Gallic	79.4	+ 2.0
Slavic	82.7	+ *16.6*
Russian	80.1	+ *5.0*
Mediterranean	79.1	— 2.6
Mean significance, national extraction groups		± 5.17

[1] Calculated from length and breadth means of groups.

[2] Based on an assumed sigma of 3.50 units for cephalic index.

groups. It is notable that in all nine of the national extraction groups, and in the eight largest of the nine regional groups, excess of head breadth is accompanied by deficiency of head length or vice versa, showing a relative stability of head size as compared with proportions. Since both head length and head breadth rate very high as differentiating measurements, it is evident that differences in cephalic index must be particularly strong. In estimating the significance of differences in the cephalic index, it is necessary to assume a standard deviation for the total group, since this was not calculated. This has been estimated as 3.5 units — a value taken uncritically from a small series of Americans measured by the author. (The value 3.3 for the civilian check sample in Hooton's American Criminal might have been used, but the larger value is more conservative in the sense that, as used here, it makes the differences appear slightly less significant.) This procedure gives a maximum significance of difference from total of 7.7 sigma for the regional groups and 16.6 sigma for the national extraction groups — far in excess of the significance of any single measurement.

No extensive comparison has been made of the cephalic index figures for the national extraction groups among Americans with data on European nationalities, since the broad extent of the categories of European extraction used in this analysis precludes any detailed correspondence. A rough comparison may be made, however, with the conveniently summarized data in Coon's Races of Europe (map, pp. 258–259). This graphic presentation affords a perspective on the large areas dealt with in the present grouping. The lowest cephalic index mean in the present series is 77.3 for Pure British. Coon's summary shows the cephalic index of Great Britain to be divided between the 76–77 and 78–79 groups, with the latter about three-fourths of the area. The American "British" thus appear to be fractionally more dolichocephalic than the British themselves. The highest cephalic index mean in the present series is 82.7 for Pure Slavic. The area here designated as Slavic ranges, in Coon's map, from 78 to 87,

the larger part of the area being about equally divided between the 82–83 and 84–85 groups. There is of course no check on which parts of this diverse area contributed most heavily to immigration. The general conclusion is nevertheless the same as in the case of the British group: the American "Slavics" are comparable to their European ancestors, with a suspicious tendency towards greater dolichocephaly, probably not more than one unit. Since the European Slavs (again according to Coon) average about sixty-five inches in stature, while their American descendants must be (even allowing for the inadequacies of the stature data in the present series) nearly 68 inches, the difference appears to be that which might be expected from increase in height. It certainly appears that the European cephalic index differences, in the intermediate groups as well as in these two extremes, have been well preserved in their transplanted members. The long established position of the cephalic index as a critical and reasonably stable indicator of ancestry is well borne out by the present analysis. The probable decrease of the cephalic index in the presence of factors favoring greater physical size is small in relation to the hereditary differences.

The question of genetic dominance of head form cannot be well assessed due to the fact that the extractions offering the greatest contrast in head form (as British vs. Slavic) have mixed with one another in only a very few individuals of the series. The only sizable groups affording any clue are the combinations of Germanic with Old American, British and Irish. The contrast in head form here is not large and the comparison is clouded by the fact that no half-and-half mixture is guaranteed and that the Germanic stocks involved may be selected for longer residence in this country and not necessarily representative of the group as a whole. However, the average cephalic index for this mixed group is 78.2 compared with 79.7 for Pure Germanic and a composite of 77.6 for their non-Germanic element. Genetic dominance of brachycephaly does not appear to be at work.

Cephalic index differences according to state of birth are, as in the case of nationality, more striking than any comparable differences in absolute measurements. Though the maximum difference is only 2.1 units as between regional groups, five of the nine regions are significantly different from the total, the maximum significance being 7.7 sigma for the relatively brachycephalic Middle Atlantic area.

The analysis of national extraction and regional differentiation is not complete without a correlation of extraction with state of birth, as presented in table 9. The differences in national extraction between different parts of the United States are striking in many respects, though of an expected nature. It should be borne in mind that these figures may be somewhat exaggerated due to the method of recording data. The principal extraction of two parents was recorded; and by this procedure minority groups, if well assimilated, so that they characteristically appear as less than half the ancestry of any parent, tend to disappear altogether from the record. Even if somewhat distorted, however, the indications of local differences are relevant. The fusion of the "melting-pot" was certainly by no means complete at the time the individuals in this series were born.

The Old American stock — a dubious group — are most frequent in the South, an area otherwise distinguished by the presence of British and Irish almost to the exclusion of other foreign extractions. The difference between Old American and British or Irish in this area is probably for the most part a function of the historical detail in which the individuals questioned chose to relate their ancestry. It is certainly the area which has been least affected by the more recent migrations to this country. The emergence of Gallic extraction in the West South Central area reflects the equally old French settlement of Louisiana.

British extraction, more or less interchangeable with Old American in many cases, does not show any regional differences worthy of mention. The Irish are principally distinguished by their nearly equal representation in all areas;

TABLE 9

National extractions (pure and mixed combined) by birthplace.

NATIONAL EXTRACTION (PER CENT)[1]	NEW ENGLAND	MIDDLE ATLANTIC	EAST NORTH CENTRAL	WEST NORTH CENTRAL	SOUTH ATLANTIC	EAST SOUTH CENTRAL	WEST SOUTH CENTRAL	MOUNTAIN	PACIFIC	FOREIGN-BORN
Old American	15.4	11.2	18.2	15.3	*49.0*	*52.2*	38.9	24.9	7.7	1.7
British	20.9	12.0	18.2	20.4	*22.9*	*24.3*	17.6	26.7	32.9	16.8
Irish	14.8	10.4	11.4	16.8	15.2	15.3	15.9	9.3	12.1	8.4
Latin American	...	0.1	0.1	0.4	0.1	...	3.8	1.9	...	1.1
Scandinavian	2.1	1.6	5.7	*14.3*	0.4	0.4	0.7	8.4	5.5	...
Germanic	2.4	*19.8*	*22.3*	22.6	6.6	5.6	8.8	16.7	21.9	14.6
Gallic	*15.4*	2.7	3.5	3.2	1.0	1.4	7.2	0.9	4.4	7.3
Slavic	10.6	*13.6*	*13.1*	3.6	1.5	0.1	0.7	2.8	1.1	17.4
Russian	5.7	*11.9*	*3.0*	1.4	0.9	0.1	1.0	...	7.7	7.9
Balkan	0.9	1.3	0.7	0.2	0.3	...	0.3	0.9	...	6.7
Mediterranean	*10.6*	14.9	3.2	1.2	2.0	0.5	5.1	7.5	4.6	12.4
Near Eastern	1.2	0.5	0.6	0.6	0.1	0.1	...	...	2.2	5.6
No. of cases	166	701	473	252	623	522	146	54	46	89

[1] In calculation of percentages, "mixed" individuals are reckoned as one-half unit for each of the stocks represented.

Italicised percentages indicate national extraction contingents which appear to have been determining influences in the physical traits of the regions.

a not unexpected result of their good representation in the older as well as newer waves of migration.

Scandinavian stock is, as might be anticipated, most frequent in the West North Central States, with a westward extension into the Mountain and Pacific areas. The Germanic groups appear to have spread from the Middle Atlantic area, avoiding New England and the South Atlantic states almost entirely, and fanned out through the North Central states into the West South Central and particularly the Mountain and Pacific regions.

Gallic extraction is most noticeable in New England — an extension in part from French Canada; and in the West South Central, as noted previously.

The Slavic immigrants, like the Germanics, have entered by way of the Middle Atlantic states, but have not noticeably extended west of the East North Central area. The Russians, entering at the same point, have hardly extended beyond the Middle Atlantic area at all. Both Slavic and Russian, however, have moved into New England more than have the Germanics.

The Mediterraneans are concentrated in the Middle Atlantic states, with however a nearly equal concentration in New England. The association of Italians and Portuguese with the fishing industry may have influenced this northward extension, which is more noticeable than that of the other comparatively recent waves of immigration.

The Pacific area deserves separate consideration, since it does not fit in well with the general distribution of nationalities. It has, in addition to population extension from the area to the east, an unexpected frequency of Russians, Gallics, and the comparatively rare Near Eastern extractions. It is evidently in a sense a secondary center of recent immigration.

The time dimension of immigration is shown by the extractions of those individuals actually foreign born. The Slavic and Mediterranean elements are particularly evident in this group. In general, the foreign born are most like, of the regional groups, the Middle Atlantic area, where the most

recent immigrants are still concentrated. It should be noted that the foreign born British and Gallic include, paradoxically, Canadians of as long standing on the continent as many Old Americans.

The general pattern of physical difference in this country is illuminated by this correlation. By historical coincidence, the peripheral dolichocephaly and central brachycephaly of Europe have been repeated in diluted form on this continent as a result of the sequence of immigration. In many respects the present regional differences in the United States can be traced to the persistence of the effect of recent migrations radiating from New York, the great port of debarcation. The old small-craft immigrations of earlier periods have left their mark on New England and particularly the southern states.

In table 9 certain percentages have been italicized. These figures were not selected because they represented elements unduly prominent in certain areas, though this is generally true. These contingents were selected on the basis of similarity of physical type between national extraction groups and regional groups, and represent the elements which might reasonably be supposed to have produced the existing regional differences. This relationship is made clearer in table 10, which lists certain very broad categories of physical type (derived quite empirically from the data of tables 6 and 7, without retrospect on any special system of racial classification.) Under each physical type are listed the regions and national extractions characterized by it.

The first type, a tall thin-faced dolichocephal, is typical of Old Americans and British and of the Old American stronghold in the southern states east of the Mississippi. The second type, which is distinguished from the first by greater width of the face and head, is typical of Scandinavian extraction and of the West North Central and to a lesser extent the Mountain and Pacific states.

The third type, diametrically opposite from the first, is short, relatively brachycephalic, and broad-faced. It char-

acterizes Germanic, Russian and Slavic extractions and the Middle Atlantic and East North Central states; i.e., the industrial north exclusive of New England. The fourth type, not too clearly marked, differs from the third in that the head breadth and bizygomatic are not high; this type is small

TABLE 10

American "types" with regions and nationalities in which they predominate.

1	Stature and head length high Head breadth and bizygomatic low	
	South Atlantic East South Central	Old American British
2	Stature high, head length average or high Head breadth and bizygomatic not low	
	West North Central Mountain Pacific	Scandinavian
3	Stature and head length low Head breadth and bizygomatic high	
	Middle Atlantic East North Central	Germanic Russian Slavic
4	Stature and head length low Head breadth and bizygomatic not high	
	New England	Gallic Mediterranean
5	Head breadth low, bizygomatic high West South Central	
6	No marked deviation from U. S. average Irish	

all over. It characterizes Gallic and Mediterranean strains and the New England area.

The fifth type is peculiar to the West South Central states, and is not parallelled by any of the European extractions. It is characterized by a strong inverse relation of head breadth and bizygomatic (which otherwise show a very general correlation) the face breadth being disproportionately high. A

clue to this may be seen in the 4% frequency of Latin American extraction in this area, though this alone could hardly account for the approximate 2.5 mm excess of face breadth relative to head breadth. Since this area, which includes Texas and Oklahoma, is not only the principal point of Mexican immigration, but also the area in which maximum infiltration of Indian blood into the general population has undoubtedly taken place, it appears probable that the excessive face breadth is the result of a tangible mongoloid admixture.

The sixth type is really no type at all; it comprises the Irish, who happen to be very close to the general averages of the total American melange, as well as very randomly distributed regionally.

SUMMARY

The study includes 3075 white enlisted men measured by the Chemical Warfare Service, representing all sections of the United States. Stature and eight head and face measurements have been correlated with state of birth and national extraction. Cephalic index, head length and breadth, and nose breadth, afford the clearest differentiation both for nationality of origin and for place of birth within the United States. Regional differences are less marked than those associated with national extraction, but are statistically considerable. Residence in the United States appears to have effected an increase of stature, at least in the shorter European stocks, with a corresponding slight decrease in cephalic index: certainty on this point is prevented by ignorance of selective factors in immigration. Differences in national extraction between different areas of the United States are found to be considerable, reflecting the historical sequence of migrations. The physical differences of the various regions appear to be primarily determined by the distribution of the various European stocks which settled them. Traces of the aboriginal population are indicated in only one area.

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ASSOCIATION OF DISPROPORTION WITH PERSONALITIES.—The main generalization to be derived from [analysis of the Grant Study series] is the principle that unilateral disharmonic bodily proportions are associated with less stable personalities, with traits indicating difficulty in making easy social adjustments, and with motivations that are less practicable and leading to more ideational (cerebrotonic) fields of endeavor. The unilateral aspect of these disproportions must be stressed. Their association with the less well-integrated personalities involves one end of the distribution curve of the bodily ratio. Thus the traits concerned are positively related to bodily proportions which represent, for example, head size big for the size of chest, and not head size small for size of chest. They are associated with shoulders big for the size of chest, and not with shoulders small for the size of chest; with hands large for the size of body, and not with hands small for the size of the body, et cetera. In the case of the extremes of the curves opposite to those defined as disproportions, there is no clear-cut association in every instance with the more stable, practical and more vital traits . . . Such a relationship does exist in certain cases and in others there is simply a deficiency of the more sensitive and complex traits.

. . . It would seem that the disproportions are constitutional, and as such their relationship to the personality traits may indicate a genetic element as a basic factor in the determination of behavior and personality. The proof of this supposition must await further studies on other groups in varying cultural settings . . .

Another subject which necessitates further study is the relationship of the disproportions with the various somatotypes. Disproportions appear to be least common in the marked endomorphs and the marked mesomorphs. They are most common in the strong ectomorphs. This does not mean that disproportions are synonymous with ectomorphy or that the underlying factor in the disproportions is the ectomorphic element.— Carl C. Seltzer. Body disproportions and dominant personality traits. Psychosomatic Med., vol. 8, no. 2, 1946, pp. 75–97.

MONGOLOID VS. MONGOLIAN EYE.— The mongoloid has short, slanting palpebral fissures which slant upward toward the lateral edge. At the medial corner the angle is covered by a skin fold, the "epicanthus" . . . It is, however, interesting to note that this epicanthal fold is entirely different from the Mongolian epicanthus which is due to overlapping of the eyelid fold above the margin of the eyelid. The eyelid of the monogoloid child is formed as in every European person. The mongoloid has a skin fold, plica marginalis fetalis, which runs sickle-shaped around the medial angle of the eye and ends beneath in the skin of the sulcus infrapalpebralis. This fold has no relationship to features found in the Mongolian race, and, as I said before, if the essential difference had been recognized from the very beginning, as Séguin did, the theory of racial retrogression could never have attained such general recognition. This plica marginalis of the mongoloid is a fetal feature, a residual, still present at birth, related to the underdevelopment of the nasion. This type of epicanthus is not rare in normal newborn European races. It is, therefore, not surprising that in Russia and the Baltic states and eastern and central Germany, between 30 and 40% of newborn babies have these folds. In normal children they disappear usually within 1 to 3 months. In mongoloids they also disappear, but at a much slower rate. I was, however, not able to find a single mongoloid with epicanthus above the age of 12 years, while the majority of mongoloids have an epicanthus below 5 years of age. After 10, the mongoloid eye has more a birdlike appearance. While the epicanthus is not a sign to rely upon, the peculiar smallness of the orbit holes is absolutely pathognomonic. As my x-ray studies show, the orbit holes are egg-shaped and lack the size seen in normal children or even cretins.— Clemens E. Benda. Mongolism and cretinism. Grune and Stratton, New York, 1946, xv + 310 pp.

A Maya Indian baby, 15 months of age, walking on "all fours." This type of locomotion is no more common among these Indians than it is among Whites. Photograph taken near Chichen Itzá, Yucatan, Mexico, by Morris Steggerda, Carnegie Institution of Washington.

FURTHER NOTES ON ALBINISM AMONG THE SAN BLAS CUNA, PANAMA

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It is the purpose of this paper to record further data concerning the incidence and sociological position of the albinos or "White Indians" that occur so frequently among the San Blas Cuna of eastern Panama[1] The writer's interests during field work with this tribe were primarily ethnological; no physical measurements were taken, but genealogies and village censuses were collected and study was made of the marriage regulations, social status and religious beliefs pertaining to the albinos.

R. G. Harris ('26) was the first (and to date, only), person to make anthropometric and genetic study of the Cuna albinos in the field. His work, done in 1925, was stimulated by observation and measurement of three adolescent Cuna albinos the previous year at the U. S. National Museum (Hrdlička, '26). Since then two Swedish ethnologists, Nordenskiöld (in 1927) and Wassén (in 1935), have made brief field visits which, however, were more concerned with other problems than with the albinos (Nordenskiöld, '38; Wassén, '38).

The earliest historical reference to albinos among the Cuna is that of Salcedo in 1640 (based on the direct observations several years earlier of the missionary Adrian de Santo Tomas), who stated that among the Tunucuna[2] there were many who were "white and blond as Flemings" (p. 130)

[1] Data collected by the author in 1940–'41 while holding a Cutting Traveling Fellowship in Columbia University, and written up with the support of a grant from the American Philosophical Society.

[2] For "Tunucuna" read "Tule Cuna"; the present-day Cuna call themselves "Tule" (humans).

Albinos are nowhere mentioned in the primary sources for the Conquest period in eastern Panama — an absence all the more remarkable in view of their otherwise detailed chronicling of the Darien tribes of that time (Raynal, 1774).[3] Of the early accounts, Wafer's is the most satisfactory. He lived among the Cuna for several months in 1681 and later wrote an admirable description of the appearance, social status and incidence of the albinos.[4] Since then numerous travelers and explorers have briefly noted their presence among the Cuna, but provide us with little else.

INCIDENCE

Wafer (p. 133) estimated an incidence of 0.3% to 0.5%. Harris (p. 29) by employing estimated total population figures and the number of observed and reported albinos, arrived at a final estimated incidence of 0.69 ±% for 1925. My own field work fortunately coincided with an official census made by the Panamanian government in November, 1940. This census, shown by cross-checks at five islands to be quite accurate for the gross count at each village, did not however discriminate between browns and albinos. The Panamanian government has not yet made available the data for each village; it has only been possible so far to obtain the tribal total and the count at thirteen of the approximately thirty inhabited islands and coastal villages. The albinos were counted by much the same methods used by Harris (pp. 29–33) viz. actual observations at some islands and carefully checked reports from the Indians for others,[5] though it was not necessary to employ estimates of the number of albinos at unvisited islands to the extent used by Harris, principally because the

[3] Contrary to the impression given in Raynal's "Histoire," quoted by Harris ('26, p. 17), that Balboa met with albinos in Darien. It appears, rather, that Raynal was interpolating later information into the situation as found by Balboa.

[4] Quoted in full by Harris, '26, pp. 18–19.

[5] As Harris noted, the mobility of the San Blas Cuna men between various island-villages greatly facilitates cross-checked reports for places not actually visited by the outsider.

present writer was able to spend a longer period in the San Blas area.

With these conditions in mind we can proceed to a consideration of the incidence of albinos in 1940. The total population for the San Blas Cuna in November of that year was 20,831 [6]; the total number of albinos was ninety-eight, yielding a percentage of 0.47 ±. Of these ninetyeight, sixty-nine were actually seen by myself, seventeen were reported by numerous informants whose statements were carefully cross-checked, and twelve were estimated on the basis of indefinite reports for several villages, Panama City, Colon and the Canal Zone. Harris's incidence of 0.69 ±% for 1925 was based on an estimated population of 20,100 of whom 138 were albinos.

The discrepancy of 0.22 ±% between these two incidences is not serious and the greater part of it can be satisfactorily explained by the limitations imposed on Harris's study, for he was more dependent on estimated population figures and estimated occurrence of albinos at unvisited islands. The smaller incidence resulting from the author's investigations should be regarded less as a refinement of Harris's figure than as a confirmation of a remarkable phenomenon greatly exceeding the usual expectation of albinism among human groups. Table 1 gives comparative data for six islands for which government census figures are available and of which four were visited both by Harris and myself. The selection was made on these bases alone and is to be regarded as typical of the whole San Blas coast, for there are a number of very small island and coastal villages that account for about a fifth of the total population but which contain no albinos.

The change in population for several of the islands is largely due to widespread movements throughout the area soon after

[6] Letter from Buró del Censo, Panama, February 1, 1941. This figure includes about 4000 Cunas, mostly young men, in Colon, Panama City and the Canal Zone. The composition of this group is constantly changing, for few of its members remain in the cities permanently. It is drawn from all the villages of the coast, though in greater proportion from the more acculturated islands than from the others. Not included are perhaps 200 men working as sailors on merchant ships throughout the world.

Harris's visit as a result of a revolution agaist the Panamanian government and strong feelings between the two political parties into which the San Blas Cuna were then (and still are) divided. The percentage increase of albinos at Aligandi and Nargana is due to longer and more consistent modern missionary influence at these two islands than elsewhere on the San Blas coast with a consequent decrease in the aboriginal practice of albino infanticide (noted below).

TABLE 1

Incidence of Albinism: 1940 vs. 1925.

Village	HARRIS ('25)			STOUT ('40)		
	Estimated population	No. of albinos	% of albinos	% of albinos	No. of albinos	Gov't. census
Aligandi	1250	12	1.0 ±	2.31 ±	14	605
Portogandi (Ustupu)	1000	5	0.5 ±	0.34 ±	4 [1]	1139
Nagana (Nargana)	1200	8	0.75 ±	1.15 ±	12	1029
Tupil (Tupile)	250	2	0.8 ±	0.64 ±	4	622
Playon Chico	300	2	0.75 ±	0.26 ±	2	756
Tigre	150	2 [1]	1.75 ±	0.69 ±	4	573
	4150	31	0.74 ±	0.84 ±	40	4724

[1] Reported by Indian informants.

Concerning the incidence of albinism among the mainland or mountain Cuna, who live in the interior of eastern Panama, it is only possible to say that it appears to be less frequent than among the San Blas Cuna. Neither Harris nor the author visited the mountain villages, but a number of informants employed by Wassén and myself consistently reported that albinos are less common among them (Harris, '26, p. 26; Wassén, '38, p. 160; Nordenskiöld, '38, p. 420). This is possibly due to a greater practice of infanticide among the mountain Cuna, for they have in general retained more of the aboriginal practices than have the Cuna on the San Blas coast.

GENETIC ASPECTS

Harris's observations (p. 36) led him to distinguish four phenotypes among the San Blas Cuna — "white," very light

brown, light brown, and brown — for each of which he assumed a genotype, but with the caution that the three shades of brown are sometimes difficult to discriminate and may not be completely accurate genotype indicators (p. 36). These are, incidentally, the same varieties of skin color distinguished by the Cuna themselves. His careful analysis of a number of genealogies (pp. 30–31, 36–40, 59–63), led him to conclude that the "white" Indians are, properly speaking, imperfect or partial albinos whose "appearance is obviously the expression of a homozygous recessive condition" (p. 57). His genealogies were collected with care and with consideration for possible confusion among informants in the use of relationship terms (pp. 31–33)[7]. My own collection of genealogical data revealed nothing to controvert Harris's conclusions, but instead has been entirely confirmatory and for that reason no further genealogical tables are being reproduced here.

In view of the anthropometric and genetic data Harris also concluded that the Cuna albinos were the result of a "mutation in one or more genes" rather than "previous miscegenation with Caucasians as they are clearly Indians, not hybrids" (pp. 42–57). This conclusion is historically supported, for though the Cuna have long been in contact with Whites they have quite consistently prohibited outsiders from breeding with them and since the middle eighteenth century Whites (and Negroes) have been permitted to remain overnight in only a very few of the island and coastal villages.[8] The lack of any mention of albinos in the various historical records for eastern Panama during the first century or so of the Conquest suggests that the mutation from which they originate may possibly have occurred in historic times, though the alternate speculation can be made that total albino infanticide was practiced at that time and has since been relaxed.

[7] As noted by him, the Cuna pattern of extended family household facilitates this aspect of field study.

[8] Information on this point is contained in a manuscript by the writer entitled "San Blas Cuna Acculturation: An Introduction."

CULTURAL ASPECTS

The continuing propagation of albinos among the San Blas Cuna can be understood only by considering the structure of Cuna society. Very few of the villages exceed 1500 persons in size and most are less than 1000. The limitation derives from the smallness of the coral islets on which most of the villages are built and from the availability of accessible, usable crop-land on the nearby mainland. The immediate family is monogamous and residence after marriage is matrilocal, so that the extended family household is composed of a group of conjugal family units related by marriage to a lineage of women. Cross and parallel cousins are terminologically distinguished from each other and from siblings; intermarriage of cross or parallel cousins is infrequent, and is not regarded as proper by the Cuna. Relations regarded as incestuous are those between siblings, half-siblings, aunt and nephew, uncle and niece, and between parent and child [9]; marriage between persons of widely divergent ages is very uncommon. Village endogamy prevails, but is not mandatory, and has decreased with recent generations. Adultery and premarital sexual relations are uncommon, for the San Blas Cuna have a strict moral code and the division of labor on the mainland and the crowded conditions of the islands afford little opportunity for clandestine affairs. Divorce, however, is easily obtained (there is no bride price that need be returned) and at many islands between a fifth and fourth of the adults have participated in two or more marriages.

Taking the above factors into account, it is still possible to attain a considerable degree of inbreeding on any one island

[9] Wafer ('03, p. 155) describes the Cuna as having the jus prima noctis, a practice no longer observed but of significance in the establishment of a genetic feature such as albinism in a population: "When they marry, the Father of the bride, or the next Man of Kin, keeps her privately in the same Apartment with himself the first seven Nights; whether to express an unwillingness to part with her, or for what other Reason I know not; and she is then deliver'd to her Husband." Winship, the editor of this particular edition of Wafer's work, footnotes this passage with another report of the same custom among the Cuna of the same period.

or among neighboring islands. This, despite albino infanticide and the regulations whereby intermarriage of albinos is forbidden and marriage of an albino with one of the shades of brown is considered undesirable and is actually very infrequent, adequately accounts for the continuing occurrence of albinos among the offspring of marriages between brown Cunas, for it still permits the recessive genetic factors to operate, as Harris also noted (pp. 34–35, 37). The genetic situation and social system are such that without albino infanticide and the restrictions on albino marriages, their incidence would be even greater.

Aside from the above restrictions there are other cultural factors delineating the albino's distinct social status in San Blas Cuna society. They are regarded as physically inferior by the brown Cunas, for they sunburn easily, have difficulty with their eyes in the daytime and are not, it is said, able to do a full day's work. There are medicines for preventing albino births,[10] and to bear an albino child is an unhappy event for a Cuna woman. Should an albino survive in infancy, any marriage it might make in later life is without the usual marriage ceremony, though albino girls are accorded the usual puberty rites given all girls. On the other hand, albinos are regarded by the brown Indians as being more intelligent, as being "closer to God" and freer of sin, and as having special powers enabling them to scare away, with a small bow and arrow, the demon devouring the sun or moon at times of eclipses. Beside being called sipu ("white") they are also referred to as ibe, an honorific meaning "sun." Finally, albinos are believed to inhabit a special level in heaven after death and there are several prominent albino culture heroes in the mythology. They are not, incidentally, segregated in special communities as is popularly believed in the Canal Zone and the Panamanian cities.

[10] There is also a medicine (but unused!) for producing albino births. (Wassén, '38, p. 158.)

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G. RAHM, M. D., who created a sensation among anthropologists by reporting in 1930 a high percentage of blood group B for the Yahgans of Tierra del Fuego, is well on his way to becoming an American citizen. This has not been without difficulty, because when Dr. Rahm came to America about 1938 he was "a man without a country." Born in China of a Belgian father and German mother, he left there at an early age, studied in Germany and France, taught in Switzerland, and visited, among other places, Chile and Easter Island. He is now a young-looking man of 61.

Dr. Rahm's real scientific interest is in suspended animation — hibernation and estivation — in animals, chiefly in nematodes. Blood grouping was a mere side-line, urged upon him by Dr. R. Kraus, one of the pioneers of immunology. Dr. Rahm feels that the sera furnished by Kraus for use on the Yahgans may have gone bad before use. (He used fresher sera in Easter Island.) He does not think that the reported high percentage of group B was due to a typographical error in a table, as his friend Lipschutz has suggested (this Journal, n.s., vol. 4, p. 309), but he does not at present have access to his original notebooks to check this point. On the whole he feels now that it does not matter a great deal. — William C. Boyd.

AN ANALYSIS OF THE SEX RATIOS AMONG SINGLE AND PLURAL BIRTHS IN THE TOTAL, THE "WHITE" AND THE "COLORED" UNITED STATES POPULATIONS

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In a previous paper (Strandskov, '45b) we discussed the sex ratios of the total births, the live births and the stillbirths within the total, the "white" and the "colored" U. S. populations from 1922 to 1936 inclusive. In this paper we are presenting and comparing the sex ratios among single and plural births within the same three major populations for the same interval.

The raw data, as before, were taken from the yearly reports of the U. S. Bureau of the Census The figures for the single births were not directly available but were derived by subtracting the plural birth frequencies from the totals. As was true before, the data include only those births for which the sex was recorded. Among the plural births they include only those sets for which the sex was recorded for all members of the set.

By considering the live births and the stillbirths among single and plural births in the total, the "white" and the "colored" populations, fifty-four different combinations or populations were obtained. These are listed in table 1. To conserve space the sub groups which make up a given combination are indicated by the following abbreviations: Wh. = "white," Cl. = "colored," Si. = single, Pl. = all plural, Tw. = twin, Tr. = triplet, Qd. = quadruplet, Li. = live birth, and

TABLE 1

The number and percentage of males among single and plural births in U. S. populations from 1922 to 1936 inclusive. Also shown are the t values which are indicative of the extent to which the observed sex ratio deviates significantly from an expected 50 : 50 ratio. The last column shows the F values which represent a comparison between the observed variance of the 15 yearly sex ratios within each population and the variance expected due to chance.

POPULATION No.	POPULATION Composition	NO. ♀ AND ♂	NO. ♂	% ♂	t VALUE	F VALUE
1	Wh.Cl., Si.Pl., Li.St.	31,860,773	16,430,417	51.569	177.09	4.13
2	Wh.Cl., Si.Pl., Li.	30,713,547	15,774,412	51.360	150.78	2.26
3	Wh.Cl., Si.Pl., St.	1,147,226	656,005	57.182	153.86	5.30
4	Wh., Si.Pl., Li.St.	28,244,869	14,575,386	51.604	170.46	3.05
5	Wh., Si.Pl., Li.	27,338,663	14,057,976	51.422	148.74	1.50
6	Wh., Si.Pl., St.	906,206	517,410	57.096	135.11	6.29
7	Cl., Si.Pl., Li.St.	3,615,904	1,855,031	51.302	49.52	1.54
8	Cl., Si.Pl., Li.	3,374,884	1,716,436	50.859	31.55	1.44
9	Cl., Si.Pl., St.	241,020	138,595	57.504	73.65	1.49*
10	Wh.Cl., Si., Li.St.	31,117,925	16,052,842	51.587	176.92	4.08
11	Wh.Cl., Si., Li.	30,027,454	15,428,262	51.381	151.26	2.26
12	Wh.Cl., Si., St.	1,090,471	624,580	57.276	151.93	4.75
13	Wh., Si., Li.St.	27,605,090	14,249,501	51.619	170.06	3.00
14	Wh., Si., Li.	26,741,685	13,755,800	51.440	149.07	1.47
15	Wh., Si., St.	863,405	493,701	57.181	133.45	4.17
16	Cl., Si., Li.St.	3,512,835	1,803,341	51.336	50.07	1.59
17	Cl., Si., Li.	3,285,763	1,672,457	50.900	32.62	1.13
18	Cl., Si., St.	227,072	130,884	57.640	72.81	1.48*
19	Wh.Cl., Pl., Li.St.	742,848	377,575	50.828	14.27	1.06*
20	Wh.Cl., Pl., Li.	686,093	346,150	50.452	7.49	1.07
21	Wh.Cl., Pl., St.	56,755	31,425	55.370	25.59	2.36
22	Wh., Pl., Li.St.	639,779	325,885	50.937	14.99	1.23*
23	Wh., Pl., Li.	596,978	302,176	50.618	9.55	1.11*
24	Wh., Pl., St.	42,801	23,709	55.394	22.32	2.37
25	Cl., Pl., Li.St.	103,069	51,690	50.151	0.97	1.12*
26	Cl., Pl., Li.	89,121	43,979	49.348	3.89	1.15*
27	Cl., Pl., St.	13,948	7,711	55.284	12.48	1.96
28	Wh.Cl., Tw., Li.St.	731,360	371,892	50.849	4.59	1.09*
29	Wh.Cl., Tw., Li.	676,266	341,370	50.479	7.88	1.19
30	Wh.Cl., Tw., St.	55,094	30,522	55.400	25.35	2.51
31	Wh., Tw., Li.St.	630,460	321,217	50.950	15.09	1.26*
32	Wh., Tw., Li.	588,810	298,139	50.634	9.73	1.11*
33	Wh., Tw., St.	41,650	23,078	55.409	22.08	2.40
34	Cl., Tw., Li.St.	100,900	50,675	50.223	1.42	1.00
35	Cl., Tw., Li.	87,456	43,232	49.433	3.35	1.09*
36	Cl., Tw., St.	13,444	7,443	55.363	12.44	2.11
37	Wh.Cl., Tr., Li.St.	11,232	5,564	49.537	0.98	2.86*
38	Wh.Cl., Tr., Li.	9,628	4,692	48.733	2.49	1.69*
39	Wh.Cl., Tr., St.	1,604	872	54.364	3.50	1.72
40	Wh., Tr., Li.St.	9,123	4,565	50.038	0.07	3.92*
41	Wh., Tr., Li.	8,010	3,957	49.401	1.07	2.92*
42	Wh., Tr., St.	1,113	608	54.627	3.09	1.22*
43	Cl., Tr., Li.St.	2,109	999	47.368	2.42	2.53
44	Cl., Tr., Li.	1,618	735	45.426	3.68	3.42
45	Cl., Tr., St.	491	264	53.768	1.67	2.33
46	Wh.Cl., Qd., Li.St.	256	119	46.484	1.13	...
47	Wh.Cl., Qd., Li.	205	92	44.878	1.47	...
48	Wh.Cl., Qd., St.	51	27	52.941	0.42	...
49	Wh., Qd., Li.St.	196	103	52.551	0 72	...
50	Wh., Qd., Li.	158	80	50.633	0.16	...
51	Wh., Qd., St.	38	23	60.526	1.30	...
52	Cl., Qd., Li.St.	60	16	26 667	3.62	...
53	Cl., Qd., Li.	47	12	25.532	3.35	...
54	Cl., Qd., St.	13	4	30.769	1.39	...

* Indicates that the variance expected due to chance is greater than the observed variance.

St. = stillbirth. To make clear the manner in which these symbols are utilized we shall state that population no. 1 of table 1 consists of all births in the total population, whereas, population no. 54 consists only of "colored" quadruplet stillbirths.

Although we calculated and made use of the percentages of male births for each year of the 15-year interval, for each of the fifty-four populations, we shall present only the percentages for the total 15-year period. The first nine populations were discussed in our previous paper (Strandskov, '45b), but the percentages for the total 15-year period for these populations are listed here once again because they are desired for comparative purposes.

Before comparing the sex ratios of the different populations, which is our main purpose, we shall consider briefly the deviation of the observed sex ratio of each population from an expected 50:50 ratio, and also examine the variation of the yearly percentages of males within each population.

Whether or not the sex ratio of a given population deviates significantly from the theoretically expected 50:50 ratio can be determined by dividing the standard error of the expected ratio into the observed deviation and by looking up in appropriate tables the probability of the quotient or t value. If a t value of 2 or more is obtained the observed deviation may be considered statistically significant. The t values for all of the fifty-four populations are presented in the next to the last column of table 1. If we examine this column we find that the sex ratios of nearly all of the different populations deviate significantly from the expected. Most of them do so in favor of males. This is in general agreement with the usual reports on human sex ratios. The probable reasons for these deviations in the male direction we have discussed previously (Strandskov, '42 and '45b). The sex ratios which deviate in favor of females we shall consider later when we compare the sex ratios of the different populations.

Some information regarding the extent to which each set of fifteen yearly percentages of males varies from year

to year can be gained by comparing the observed variance of each distribution of male percentages with the variance expected due to chance. Fisher ('35) has shown that it is possible to calculate the probability that one variance is a certain number of times greater than another. The degree to which one is greater than another he has called the statistic F. Snedecor ('38) has provided us with a table of probabilities of F values. The F values which are obtained for forty-five of the fifty-four populations are shown in the last column of table 1. (The quadruplet populations are omitted because the yearly numbers for each of these populations are too small to permit a statistical analysis.) As may be seen from an examination of table 1 the observed variance in some instances is shown to be larger than the variance expected due to chance. When this is true an F value of 1.69 has a probability of 0.05 and an F value of 2.07 a probability of 0.01. In a few of the populations the variance expected due to chance is the larger. In these instances an F value of 2.13 has a probability of 0.05 and an F value of 3.00 a probability of 0.01. All F values which belong in the latter category are indicated by an asterisk. As we have already pointed out, an examination of table 1 reveals that the observed variance of the male percentages of some of the populations is significantly larger than the variance expected due to chance. This, for example, is true for populations no. 1, 2, 3, 4, etc. When this is true what explanation may be offered? Are the responsible factors genetic, or environmental, or in part both types? We shall not discuss this question at length, but we do wish to point out that an examination of the F values of all the different populations suggests that the responsible factors are primarily environmental. At least it seems clear that environmental factors can and do affect the percentages of males among stillbirths within a given population.

We may turn now to a statistical comparison of the sex ratios of the different populations. This can be done by

applying the standard formula for a test of the significance of the difference between two means:

$$t = \frac{\Delta}{\sqrt{\frac{\Sigma(X_1-\overline{X}_1)^2 + \Sigma(X_2-\overline{X}_2)^2}{N_1 + N_2 - 2} \times \frac{N_1 + N_2}{N_1\ N_2}}}$$

A t value greater than 2 has a probability less than 0.05 and may, therefore, be considered indicative of a significant difference. We have not made all of the sex ratio comparisons which are possible, but have selected sixty-six pairs which in our opinion include all or at least most of those of interest. The t value for these are given in table 2. The quadruplet populations are not included in any of the comparisons, because, as we have indicated previously, their yearly numbers are too small to permit a statistical treatment.

If we examine table 2 we find that the sex ratios of most of the populations which are compared are significantly different. In order to show clearly the differences in the percentage of males among single and plural births we have arranged these populations and their percentages in a special order in table 3. From an inspection of this table it may be seen that in the first population, which combines "white" and "colored" live births and stillbirths, the percentage of males decreases with each increase in number of embryos per pregnancy. It decreases from 51.587 among single pregnancies, to 50.849 among twins, to 49.537 among triplets, to 46.484 among quadruplets. The differences between the first three of these percentages are statistically significant as may be seen from table 2. (Quadruplet percentages are not tested because of small numbers.) The same decreasing trend holds for the percentages of males, among the live births and the stillbirths combined, in both the "white" and the "colored" populations considered separately. It also holds in all three populations among live births and stillbirths considered separately. In other words it seems universally true that the percentage of males in the human species decreases with each increase in number per pregnancy, or as the mammalogist

TABLE 2

A comparison of the sex ratios among single and plural births in the total, the "white" and the "colored" U. S. populations from 1922 to 1936 inclusive. The population with the larger percentage of males is shown first. For the meaning of the abbreviations see text.

POPULATION				vs.	POPULATION				t* VALUE
No.	Composition				No.	Composition			
3	Wh.Cl.,	Si.Pl.,	St...	vs.	2	Wh.Cl.,	Si.Pl.,	Li...	54.31
6	Wh...,	Si.Pl.,	St...	vs.	5	Wh...,	Si.Pl.,	Li...	43.23
9	Cl...,	Si.Pl.,	St...	vs.	8	Cl...,	Si.Pl.,	Li...	73.97
12	Wh.Cl.,	Si...,	St...	vs.	11	Wh.Cl.,	Si...,	Li...	55.46
15	Wh...,	Si...,	St...	vs.	14	Wh...,	Si...,	Li...	52.33
18	Cl...,	Si...,	St...	vs.	17	Cl...,	Si...,	Li...	73.62
21	Wh.Cl.,	Pl...,	St...	vs.	20	Wh.Cl.,	Pl...,	Li...	15.12
24	Wh...,	Pl...,	St...	vs.	23	Wh...,	Pl...,	Li...	12.74
27	Cl...,	Pl...,	St...	vs.	26	Cl...,	Pl...,	Li...	9.69
30	Wh.Cl.,	Tw...,	St...	vs.	29	Wh.Cl.,	Tw...,	Li...	14.55
33	Wh...,	Tw...,	St...	vs.	32	Wh...,	Tw...,	Li...	14.55
36	Cl...,	Tw...,	St...	vs.	35	Cl...,	Tw...,	Li...	9.16
39	Wh.Cl.,	Tr...,	St...	vs.	38	Wh.Cl.,	Tr...,	Li...	3.73
42	Wh...,	Tr...,	St...	vs.	41	Wh...,	Tr...,	Li...	4.12
45	Cl...,	Tr...,	St...	vs.	44	Cl...,	Tr...,	Li...	2.61
10	Wh.Cl.,	Si...,	Li.St.	vs.	19	Wh.Cl.,	Pl...,	Li.St.	12.87
11	Wh.Cl.,	Si...,	Li...	vs.	20	Wh.Cl.,	Pl...,	Li...	14.54
12	Wh.Cl.,	Si...,	St...	vs.	21	Wh.Cl.,	Pl...,	St...	5.57
13	Wh...,	Si...,	Li.St.	vs.	22	Wh...,	Pl...,	Li.St.	11.63
14	Wh...,	Si...,	Li...	vs.	23	Wh...,	Pl...,	Li...	13.13
15	Wh...,	Si...,	St...	vs.	24	Wh...,	Pl...,	St...	4.60
16	Cl...,	Si...,	Li.St.	vs.	25	Cl...,	Pl...,	Li.St.	8.21
17	Cl...,	Si...,	Li...	vs.	26	Cl...,	Pl...,	Li...	10.05
18	Cl...,	Si...,	St...	vs.	27	Cl...,	Pl...,	St...	4.06
10	Wh.Cl.,	Si...,	Li.St.	vs.	28	Wh.Cl.,	Tw...,	Li.St.	12.57
11	Wh.Cl.,	Si...,	Li...	vs.	29	Wh.Cl.,	Tw...,	Li...	13.83
12	Wh.Cl.,	Si...,	St...	vs.	30	Wh.Cl.,	Tw...,	St...	5.28
13	Wh...,	Si...,	Li.St.	vs.	31	Wh...,	Tw...,	Li.St.	11.50
14	Wh...,	Si...,	Li...	vs.	32	Wh...,	Tw...,	Li...	12.79
15	Wh...,	Si...,	St...	vs.	33	Wh...,	Tw...,	St...	4.48
16	Cl...,	Si...,	Li.St.	vs.	34	Cl...,	Tw...,	Li.St.	7.21
17	Cl...,	Si...,	Li...	vs.	35	Cl...,	Tw...,	Li...	9.16
18	Cl...,	Si...,	St...	vs.	36	Cl...,	Tw...,	St...	3.73
10	Wh.Cl.,	Si...,	Li.St.	vs.	37	Wh.Cl.,	Tr...,	Li.St.	7.26
11	Wh.Cl.,	Si...,	Li...	vs.	38	Wh.Cl.,	Tr...,	Li...	6.78
12	Wh.Cl.,	Si...,	St...	vs.	39	Wh.Cl.,	Tr...,	St...	1.41
13	Wh...,	Si...,	Li.St.	vs.	40	Wh...,	Tr...,	Li.St.	5.84
14	Wh...,	Si...,	Li...	vs.	41	Wh...,	Tr...,	Li...	6.16
15	Wh...,	Si...,	St...	vs.	42	Wh...,	Tr...,	St...	1.48
16	Cl...,	Si...,	Li.St.	vs.	43	Cl...,	Tr...,	Li.St.	2.37
17	Cl...,	Si...,	Li...	vs.	44	Cl...,	Tr...,	Li.St.	2.50
18	Cl...,	Si...,	St...	vs.	45	Cl...,	Tr...,	Li.St.	0.51
28	Wh.Cl.,	Tw...,	Li.St.	vs.	37	Wh.Cl.,	Tr...,	Li.St.	4.54
29	Wh.Cl.,	Tw...,	Li...	vs.	38	Wh.Cl.,	Tr...,	Li...	4.32
30	Wh.Cl.,	Tw...,	St.	vs.	39	Wh.Cl.,	Tr...,	St...	0.27
31	Wh...,	Tw...,	Li.St.	vs.	40	Wh...,	Tr...,	Li.St.	3.25
32	Wh...,	Tw...,	Li...	vs.	41	Wh...,	Tr...,	Li...	3.63
33	Wh...,	Tw...,	St...	vs.	42	Wh...,	Tr...,	St...	0.17
34	Cl...,	Tw...,	Li.St.	vs.	43	Cl...,	Tr...,	Li.St.	1.69
35	Cl...,	Tw...,	Li...	vs.	44	Cl...,	Tr...,	Li...	1.83
36	Cl...,	Tw...,	St...	vs.	45	Cl...,	Tr...,	St...	0.18
4	Wh...,	Si.Pl.,	Li.St.	vs.	7	Cl...,	Si.Pl.,	Li.St.	7.76
5	Wh...,	Si.Pl.,	Li...	vs.	8	Cl...,	Si.Pl.,	Li...	15.73
9	Cl...,	Si.Pl.,	St...	vs.	6	Wh...,	Si.Pl.,	St...	2.80
13	Wh...,	Si...,	Li.St.	vs.	16	Cl...,	Si...,	Li.St.	7.04
14	Wh...,	Si...,	Li...	vs.	17	Cl...,	Si...,	Li...	14.96
18	Cl...,	Si...,	St...	vs.	15	Wh...,	Si...,	St...	3.44
22	Wh...,	Pl...,	Li.St.	vs.	25	Cl...,	Pl...,	Li.St.	5.21
23	Wh...,	Pl...,	Li...	vs.	26	Cl...,	Pl...,	Li...	7.76
24	Wh...,	Pl...,	St...	vs.	27	Cl...,	Pl...,	St...	0.24
31	Wh...,	Tw...,	Li.St.	vs.	34	Cl...,	Tw...,	Li.St.	4.52
32	Wh...,	Tw...,	Li...	vs.	35	Cl...,	Tw...,	Li...	7.09
33	Wh...,	Tw...,	St...	vs.	36	Cl...,	Tw...,	St.	0.13
40	Wh...,	Tr...,	Li.St.	vs.	43	Cl...,	Tr...,	Li.St.	1.61
41	Wh...,	Tr...,	Li...	vs.	44	Cl...,	Tr...,	Li...	1.83
42	Wh...,	Tr...,	St...	vs.	45	Cl...,	Tr...,	St...	0.21

* A t value greater than 2 has a probability less than .05.

would say, with each increase in size of litter. Nichols ('07) and Knibbs ('25) obtained somewhat similar results.

What explanation may be offered for these decreases? It is, of course, well known that more males than females die during the gestation period within the human species. As our data show this is true even among single conceptions. Hence the explanation which immediately comes to mind is that

TABLE 3

The percentages of males among single, twin, triplet and quadruplet births in the total, the "white" and the "colored" U. S. populations from 1922 to 1936 inclusive.

POPULATION	PERCENTAGE OF MALES AMONG SINGLE AND PLURAL BIRTHS			
	Single	Twin	Triplet	Quadruplet
Wh.Cl., Li.St.	51.587	50.849	49.537	46.484
Wh. . ., Li.St.	51.619	50.950	50.038	52.551
Cl. . ., Li.St.	51.336	50.223	47.368	26.667
t value Wh. vs. Cl.	7.04	4.52	1.61	. . . . .
Wh.Cl., Li. . .	51.381	50.479	48.733	44.878
Wh. , Li. . .	51.440	50.634	49.401	50.633
Cl. . ., Li. . .	50.900	49.433	45.426	25.532
t value Wh. vs. Cl.	14.96	7.09	1.83	. . . . .
Wh.Cl., St. . .	57.276	55.400	54.364	52.941
Wh. . ., St. . .	57.181	55.409	54.627	60.526
Cl. . ., St. . .	57.640	55.363	53.768	30.769
t value Wh. vs. Cl.	3.44	0.13	0.21	. . .

male embryos under competition or under population pressure, tend to be eliminated to an even greater extent than do female embryos. It must be pointed out, however, that if this explanation is the correct one then the greater tendency for the elimination of the male embryo among plural pregnancies must occur early in pregnancy and not during later stages, because as table 3 shows, even among stillbirths the percentage of males decreases with each increase in number per pregnancy. Most of the recorded stillbirths, it must be recalled, represent advanced stages in development.

Another possible explanation for the observed decrease in the percentage of males with each increase in number per pregnancy is that the female determined zygote has a greater tendency to twin, or triple, or quadruple, than does the male determined zygote. If this explanation is the correct one then the decrease would, of course, occur only among monozygotic twins, triplets, and quadruplets, but would be reflected in the totals which combine both types.

Although the second suggested hypothesis is a possibility, and the facts agree with it throughout, we are inclined to favor the first one. We must admit, however, that we can not advance any deciding arguments in its favor.

Since we appear to have conclusive proof that the percentages of males which are born decreases in the human species with each increase in number per pregnancy, it is of interest to examine this question with respect to lower mammals. Wentworth ('14) found no correlation between litter size and sex ratio in the pig and in the dog. King and Stotsenburg ('15) examined data pertaining to the albino rat and reported no correlation. Sumner, McDaniel and Huestis ('22) obtained inconclusive results from studies on the deer-mouse, and Parkes ('26) found no positive or negative relationship in the laboratory mouse. However, Johansson ('32) in his study of the sex ratio among multiple births in cattle did find a decrease with each increase in number of embryos per pregnancy. The percentages of males which he obtained are as follows: single births 51.52, twins 48.84 and triplets 45.95. The differences are statistically significant. Accordingly it appears probable that among normally multiparous animals no significant decrease takes place in the percentage of males born with each increase in number per pregnancy, whereas, among normally uniparous animals such as man, a decrease does occur.

In a previous paper (Strandskov, '45b) we showed that the percentage of males among all births (i.e., live births and stillbirths combined) is significantly lower in the "colored" population than it is in the "white." From an in-

spection of table 3 it may be seen that this same relationship holds among single, twin and triplet births. The t values are listed below the columns of the first subdivision of table 3. (The quadruplet numbers are small, therefore the percentages which are shown for them are not reliable.) These observed racial differences in sex ratio among all the different types of births probably are due to differences in environmental as well as genetic factors. Which ones play the greater rôle can not be satisfactorily determined from the present data, but we are inclined to think that hereditary factors do.

We also showed in our previous paper (Strandskov, '45b) that the percentage of males among all "colored" stillbirths is significantly higher than that among all "white" stillbirths. As may be seen from table 3 this same relationship holds among single stillbirths. These racial differences among stillbirths probably are due primarily to environmental factors and to a small extent to heredity. Among twin and triplet stillbirths the percentage of males is not significantly higher for the "colored" population than it is for the "white." In fact it tends to be lower. This could be explained if one assumed that with increased competition in utero the males which are going to die tend to die early and, therefore, are not included among recorded stillbirths.

SUMMARY

1. The sex ratios among single, twin, triplet and quadruplet births, within the total the "white" and the "colored" U. S. populations from 1922 to 1936 inclusive, are presented.

2. By combining sub-groups in different ways fifty-four different combinations or populations are obtained for consideration. The sex ratio of most of these populations deviate significantly from a 50:50 ratio. Most of them do so in favor of males, but a few do so in favor of females.

3. It is found that the observed variance of the fifteen yearly percentages of males of some of the populations is greater than the variance expected due to chance. This, in particular, is true for the percentages of males among still-

births. The conclusion is drawn that this excess observed variance probably is due primarily to variations in environmental factors.

4. It is conclusively shown that the percentage of male births among all births decreases significantly in the human species with each increase in number of embryos per pregnancy. Two hypotheses are suggested. One is that male embryos tend to be eliminated to a greater extent than female embryos with increased competition. The other suggested hypothesis is that female determined zygotes tend to twin, triple or quadruple to a greater extent than do male determined zygotes. The first hypothesis is favored.

5. It is found that the percentage of males among live births and stillbirths combined, is significantly lower among single, twin and triplet births within the "colored" population than among the corresponding births of the "white" population. These racial differences probably are due primarily to racial genetic factors but probably also to some extent to racial environmental factors. The percentage of males among "colored" single stillbirths is significantly larger than that among "white" single stillbirths. This probably is due largely to racial environmental differences.

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TISSUE RESTORATION FROM SKULL TO HEAD.— The modeling of a head from a skull is in itself not new — certainly it is not original with me. Archaeologists have used this device to depict how a people, long dead, must have looked in life. Some criminologists have used the idea. But always the skull has been that of an unknown, with absolutely no opportunity to check the correctness or adequacy of the restoration.

In this report I am, for the first time — as far as I know — reporting an experiment where the procedure has gone from a known head, to the skull, and finally to a restoration in the form of a bust modeled in clay.

The problem may be stated as follows: how accurate, how reliable, is a head restoration based upon an individual skull, usually an unknown skull? Or, to put it in a more dynamic fashion, can heads so restored be useful for purposes of identification?

The problem we have set has, we think, been reasonably well answered. The restoration was readily recognizable.— Wilton Marion Krogman. The reconstruction of the living head from the skull. F. B. I Law Enf. Bull., vol. 15, no. 7, 1946, pp. 11–18.

CRANIA FROM VERKHNE-SALTOV, UKRAINE.— The Verkhne-Saltov burial ground, first discovered in 1900, is located in the lowlands on the right bank of the Donets in the Volchansk Okrug of Kharkov Oblast.

To the south of the village lies a large gorodische, containing remains of stone walls. The burial ground is located on the hills west of the village. It is not known whether there is any connection between the gorodishche and the burial ground, since only the latter has been excavated.

Saltov burial ground has been explored by many archeologists — particularly V. A. Babenko, A. M. Pokrovskii, A. S. Fedorovskii, E. P. Trifiliev, and N. E. Makavenko. The skeletal materials, however, have never been described. Pokrovskii pointed out the small stature of the skeletons and stated that the C. I. was 75.

The problem of the national affinities of the ancient inhabitants of Saltov has not been solved. Several contradictory hypotheses on this subject have been expressed by various authors.

Chuchukalo summarizes the various hypotheses regarding the ethnic origin of these people by stating that he does not hold with the theory of their Turko-Tatar, Slavic or Alan affinities.

There is no doubt, however, that Saltov should be attributed to the eighth-ninth centuries and that the Saltovo people were nomads, roaming over the extensive area between North Caucasus and Kharkov region and having several bases or settlements, one of which was Saltov.

The solution of the problem of the origin of the Saltovo people has been attempted only from the historical and anthropological points of view. At the same time, anthropological data may be of certain value.

Part of the bones from the Saltov are preserved in the Anatomical Museum of the Kharkov Institute for Popular Education. This material, consisting of forty-four crania and 142 long bones, has been used in the present investigation. The majority of the crania are elliptical with little-developed parietal eminences, occipital protrusion or glabella. The fossa canina is relatively well marked and the sagittal and coronary sutures are not complicated. Two skulls possess Wormian bones near bregma, which is rare; two others have them near pterion. The majority of the crania present a relatively uniform appearance which indicates homogeneity.

In size the Saltov crania tend to be small, dolicho- to sub-dolichocephalic (C.I. 75.04). They are also characterized by being orthocrane, mesoprosopic, leptorrhine, and mesoconch.— Henry Field and Eugene Prostov. Translated and summarized from a communication received from G. I. Chuchukalo entitled "Cherepa Verkhne-Saltovskogo Mogilnika." The complete text in Russian with statistical tables (16 pp.) has been placed on Microfilm no. 2214 in the American Documentation Institute, 1719 N Street, N. W. Washington, D. C., where a copy can be purchased.

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